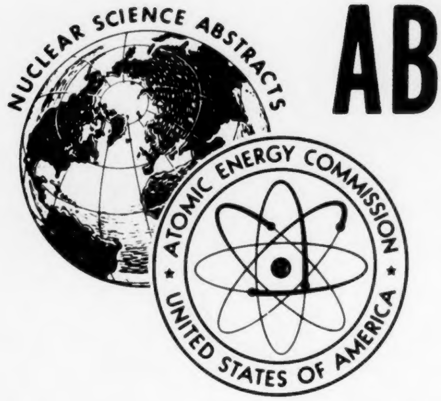
NUCLEAR SCIENCE ABSTRACTS



Volume 28 Number 3

Abstracts 5086-7834

August 15, 1973

UNITED STATES ATOMIC ENERGY COMMISSION

REPORT COLLECTIONS IN THE UNITED STATES

The libraries listed below purchase and maintain microfiche collections of USAEC and foreign reports that are abstracted in *NSA*. Their collections also include *NSA* and its indexes, AEC's Technical Progress Reviews, AEC-sponsored translations, conference proceedings published by AEC, and various bibliographic tools. Most of these libraries have microfiche reader-printers or other photocopy facilities with which to reproduce enlarged copies from microfiche. Charges for reproduction services vary.

Report collections of USAEC reports in countries other than the United States are listed on the inside back cover.

ALABAMA
Auburn, Auburn University
Tuskegee Institute, Tuskegee Institute

ALASKA
College, University of Alaska

ARIZONA
Tucson, University of Arizona

CALIFORNIA
Davis, University of California
Los Angeles, University of California
Santa Barbara, University of California

COLORADO
Boulder, University of Colorado

DISTRICT OF COLUMBIA
Washington, Library of Congress

FLORIDA
Gainesville, University of Florida

GEORGIA
Atlanta, Georgia Institute of Technology

HAWAII
Honolulu, University of Hawaii

IDAHO
Pocatello, Idaho State University

ILLINOIS
Urbana, University of Illinois

INDIANA
Lafayette, Purdue University

IOWA
Ames, Iowa State University

KANSAS
Manhattan, Kansas State University

KENTUCKY
Lexington, University of Kentucky

MARYLAND
Baltimore, Johns Hopkins University
College Park, University of Maryland

MASSACHUSETTS
Cambridge, Massachusetts Institute of Technology
Worcester, Worcester Polytechnic Institute

MICHIGAN
Ann Arbor, University of Michigan

MISSISSIPPI
State College, Mississippi State University

MISSOURI
Columbia, University of Missouri
Kansas City, Linda Hall Library

NEW JERSEY
Princeton, Princeton University

NEW MEXICO
Albuquerque, University of New Mexico

NEW YORK
Albany, New York State Library
Albany, State University at Albany
Ithaca, Cornell University
New York, Columbia University
Rochester, University of Rochester
Syracuse, Syracuse University
Troy, Rensselaer Polytechnic Institute

NORTH CAROLINA
Raleigh, North Carolina State University

OHIO
Cincinnati, University of Cincinnati
Cleveland, Cleveland Public Library

OHIO (Continued)
Columbus, Ohio State University
Toledo, University of Toledo

OKLAHOMA
Norman, University of Oklahoma

PENNSYLVANIA
Philadelphia, University of Pennsylvania
Pittsburgh, Carnegie Library
University Park, Pennsylvania State University

PUERTO RICO
San Juan, University of Puerto Rico

SOUTH CAROLINA
Columbia, University of South Carolina

TENNESSEE
Knoxville, University of Tennessee

TEXAS
Austin, University of Texas
College Station, Texas A & M University
Houston, Rice University

UTAH
Salt Lake City, University of Utah

VIRGINIA
Blacksburg, Virginia Polytechnic Institute
Charlottesville, University of Virginia

WASHINGTON
Pullman, Washington State University
Seattle, University of Washington

WEST VIRGINIA
Morgantown, West Virginia University

WISCONSIN
Madison, University of Wisconsin

USAEC reports so indicated in *Nuclear Science Abstracts* are offered for sale by National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22151.

Volume 28, Number 3, August 15, 1973

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Office of Information Services, John A. Harris, Director.
Published by the USAEC Technical Information Center, Robert L. Shannon, Manager.

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

The following organizations scan and abstract the nuclear science literature in their respective countries:

- Atomic Energy of Canada Limited
- Australian Atomic Energy Commission
- Danish Atomic Energy Commission
- Finnish Atomic Energy Commission
- French Atomic Energy Commission
- Japan Atomic Energy Bureau–Atomic Energy Research Institute
- Institutt for Atomenergi (Norway)
- Aktiebolaget Atomenergi (Sweden)
- United Kingdom Atomic Energy Authority
- Zentralstelle für Atomkernenergie-Dokumentation (West Germany)

Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts.* The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

HOW TO OBTAIN NUCLEAR SCIENCE ABSTRACTS

Nuclear Science Abstracts is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

Commencing in 1973, *NSA* will be issued in two volumes per calendar year. Volume 27 will consist of 12 regular issues January through June, and Volume 28 will consist of 12 regular issues July through December.

For the two 12-issue volumes, the annual subscription rate is $75.50 for domestic subscribers and $94.50 for foreign subscribers. A single issue costs $3.25 domestic rates or $4.07 foreign rates. Domestic rates apply to the United States, Canada, Mexico, and Central and South American countries except Argentina, Brazil, Guyana, French Guiana, Surinam, and British Honduras.

Indexes will be cumulated only for each volume, i.e., on a six-month volume basis.

The annual subscription rate for the two volume indexes is $62.00 for domestic subscribers and $77.50 for foreign subscribers.

The following cumulative indexes are available:

From Johnson Reprint Corporation, 111 Fifth Avenue, New York, N. Y. 10003:

Vols. 1–4, Subjects and Authors (1948–1950), $30.00.

From Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402:

Vols. 5–10, Subjects and Authors (1951–1956), $5.25.

Vols. 11–15, Subjects (1957–1961), $19.00.
Vols. 11–15, Personal Authors (1957–1961), $14.25.
Vols. 11–15, Corporate Authors (1957–1961), $2.50.

Vols. 16–20, Subjects (1962–1966), $36.00.
Vols. 16–20, Personal Authors (1962–1966), $22.50.
Vols. 16–20, Corporate Authors (1962–1966), $3.75.

Vol. 21, Subjects and Authors (1967), $16.00.
Vol. 22, Subjects and Authors (1968), $26.00
Vol. 23, Subjects and Authors (1969), $25.75.
Vol. 24, Subjects and Authors (1970), $22.50.
Vol. 24, Authors (1970), Suppl., $2.00.
Vol. 25, Subjects and Authors (1971), $27.50.
Vol. 26, Subjects and Authors (1972), $37.75.

Cumulative Report Number Index, Vols. 1–15 Revised, $4.00.

Cumulative Report Number Index, Vols. 16–20 Revised, $5.50.

Cumulative Report Number Index, Vols. 21–26, $9.00.

Nuclear Science Abstracts is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Government agencies may obtain *NSA* free of charge. Inquiries should be directed to the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

Nuclear Science Abstracts is also available on 16-mm and 35-mm microfilm in reel or cartridge from Princeton Microfilm Corporation, Alexander Road, Princeton, New Jersey 08540. The cost of Vols. 1–26 (1948–1972) including *Abstracts of Declassified Documents* (1947–1948) is $730.00. The indexes for *Nuclear Science Abstracts* Vols. 1–26 (1948–1972) are also available for $385.00. The cost of each volume (six months) of *NSA* and its indexes is $45.

INDEXES TO NSA

Comprehensive indexes appear in each issue and are cumulated at the end of each volume except report number indexes which will be cumulated on a calendar year basis every two volumes. Multivolume cumulations have been issued as indicated above.

All documents abstracted are indexed by subjects and personal authors. Report literature is indexed also by corporate author and report number. Each of these indexes in every issue is preceded by an introduction explaining in detail the organization of the index and the principles by which it is compiled. The reader is referred to these explanations for information not found in the brief summary below.

Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

```
DIENSTBIER, Z., Effect of para-aminomethylbenzoic acid on
    the post-irradiation disturbance of haemocoagulation in
    dogs after whole-body exposure to 600 R,  27:20122
DIERCKX, R., Determination of the fast neutron spectrum at
    the L54 reactor core center,  27:21880
DIETZEL, H., HEOS 2 and HELIOS micrometeoroid experiments,
    27:20588
```

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

```
ACCELERATOR FACILITIES/DESIGN
  Design of a neutron therapy facility for a 30-inch
    cyclotron, 27:25413
ACETONE/RADIOLYSIS
  Pulse radiolysis of alkyl ketones, 27:24388
  Radiothermoluminescence of aliphatic ketones (Gamma
    radiation), 27:24389
AEROSOL GENERATORS/OPERATION
  Operating characteristics of two compressed air
    nebulizers used in inhalation experiments, 27:24522 (LF-
    -45)
```

Corporate Authors

Technical report literature is indexed from the name of the organization or institution responsible for the issuance of the report.

21102 (ORNL–4846) GAMMA-RAY PRODUCTION DUE TO NEUTRON INTERACTIONS WITH COPPER FOR INCIDENT NEUTRON ENERGIES BETWEEN 1.0 AND 20 MeV: TABULATED DIFFERENTIAL CROSS SECTIONS. Dickens, J. K.; Love, T. A.; Morgan, G. L. **(Oak Ridge National Lab., Tenn).** Feb 1973. Contract W-7405-eng-26. 44p. Dep. NTIS $4.00.

is indexed as:

```
OAK RIDGE NATIONAL LAB., TENN.
  Gamma-ray production due to neutron interactions with
    copper for incident neutron energies between 1.0 and 20
    MeV:  tabulated differential cross sections,  27:21102
    (ORNL-4846)
```

Report Numbers

Technical report literature is also indexed by report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

ORNL-		
4811	27-21462	Dep. NTIS, 133p.
4840	27-19984	Dep. NTIS, 8p.
4846	27-21102	Dep. NTIS $4.00, 44p.
ORNL-EIS-		
73-52(Vol. 1)(No.2)	27-21978	Dep. NTIS, 13p.
ORNL-NSF-EP-		
31	27-22013	Dep. NTIS, 87p.
32	27-22014	Dep. NTIS, 83p.
33	27-22015	Dep. NTIS, 97p.
34	27-22016	Dep. NTIS, 89p.
35	27-22017	Dep. NTIS, 98p.

AVAILABILITY OF PUBLICATIONS ABSTRACTED

Public availability of all U. S. Atomic Energy Commission reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

TABLE OF CONTENTS

Volume 28, Number 3, August 15, 1973

Category *Page*

- **CHEMISTRY** 479
  - Analytical and Separations Chemistry 479
    - *Activation and Nuclear Reaction Procedures* 479
    - *Chemical and Spectral Procedures* 483
    - *Radiometric and Radiochemical Procedures* 487
    - *Separation Procedures* 490
  - Inorganic, Organic, and Physical Chemistry 493
    - *Chemical and Physicochemical Properties* 493
    - *Isotope Effects* 494
    - *Isotope Exchange and Isotope Separation* 497
    - *Feed Materials Processing* 498
  - Radiation Chemistry 498
  - Radiochemistry and Nuclear Chemistry 505
    - *Hot-Atom Chemistry* 505
    - *Properties of Radioactive Materials* 506
    - *Radioactive Waste Treatment* 510
    - *Radioisotope Production* 511
    - *Reactor Fuel Reprocessing* 512

- **ENGINEERING** 513
  - Energy Conversion 513
  - Facilities and Equipment 514
  - Heat Transfer and Fluid Flow 515
  - Materials Testing 517
  - Nuclear Explosions 518
  - Protective Structures and Equipment 519
  - Safety Engineering 520
  - Vacuum Engineering 520

- **ENVIRONMENTAL AND EARTH SCIENCES** 521
  - Minerals and Ores 521
  - Radioactive Effluents 521
  - Radioactivity Monitoring and Transport 523
    - *Atmosphere* 525
    - *Soil* 525
    - *Water* 526
    - *Ecosystems and Food Cycles* 526
  - Radiometric Techniques 527
  - Site Surveys 528
  - Thermal Effluents 529
  - Chemical Effluents 530

- **INSTRUMENTATION** 531
  - Radiation Detection Instruments 531
    - *General Detectors and Monitors* 531
    - *Radiation Dosimeters* 540
    - *Nuclear Spectroscopic Instrumentation* 541
    - *High Energy Physics Instrumentation* 545
  - Radiometric Instruments 547
  - Radiation Effects on Instrument Components, Instruments, or Electronic Systems 548
  - Miscellaneous Instruments 549

- **ISOTOPE AND RADIATION SOURCE TECHNOLOGY** 552
  - Isotope Separation (Industrial) 552
  - Isotopic Power Sources 552

Category *Page*

- **ISOTOPE AND RADIATION SOURCE TECHNOLOGY (Cont'd.)**
  - Radiation Sources 554
    - *Design and Fabrication* 555
    - *Industrial Uses* 555

- **LIFE SCIENCES** 557
  - Radiation Effects on Biochemicals 557
  - Radiation Effects on Cells 558
  - Radiation Effects on Microorganisms 559
  - Radiation Effects on Plants 562
  - Radiation Effects on Animals 565
    - *Man* 565
    - *Vertebrates* 569
    - *Invertebrates* 575
  - Radionuclide Effects (Internal Source) 577
    - *Man* 577
    - *Animals* 577
  - Nuclide Kinetics and Toxicology 578
    - *Man* 578
    - *Animals* 579
    - *Plants* 580
    - *Microorganisms* 580
  - New Tracer Techniques 580

- **MATERIALS** 583
  - Ceramics and Cermets 583
  - Metals and Alloys 591
    - *Corrosion and Erosion* 591
    - *Preparation and Fabrication* 594
    - *Properties, Structure, and Phase Studies* 595
    - *Radiation Effects* 607
  - Other Materials 608

- **NUCLEAR MATERIALS AND WASTE MANAGEMENT** 619
  - Accountability and Safeguards 619
  - Disposal and Storage 619
  - Handling Equipment and Procedures 620
  - Transportation 621

- **PARTICLE ACCELERATORS** 622
  - Design, Development, and Operation 622
  - Auxiliaries and Components 623
  - Ion Sources and Injection and Extraction Systems 623
  - Ion Optics and Field Calculations 624
  - Storage Rings 624
  - Experimental Facilities 625

- **PHYSICS (ASTROPHYSICS AND COSMOLOGY)** 627
  - Cosmic Radiation 627
  - Stars 628
  - Quasi-Stellar, Radio, and X-Ray Sources 630
  - Solar Phenomena 631
  - Galaxies 632
  - Cosmology 633
  - Planetary Phenomena 634

TABLE OF CONTENTS (continued)

Category *Page*

- **PHYSICS (ATMOSPHERIC)** 636
  - Auroral and Ionospheric Phenomena 636
  - Magnetospheric Phenomena 639
- **PHYSICS (ATOMIC AND MOLECULAR)** 641
  - Beams and Their Reactions 641
  - Atomic and Molecular Properties 641
  - Positronium, Muonium, and Muonic and Mesic Atoms and Molecules 642
  - Collision Phenomena 643
  - Atomic Theory 644
- **PHYSICS (ELECTROFLUID AND MAGNETOFLUID)** 646
- **PHYSICS (HIGH-ENERGY)** 647
  - Particle Interactions and Properties (Experimental) 647
    - *Electromagnetic* 647
    - *Weak* 647
    - *Strong (Baryon-induced)* 648
    - *Strong (Meson-induced)* 649
  - Particle Interactions and Properties (Theoretical) 649
    - *General* 649
    - *Electromagnetic* 651
    - *Weak* 653
    - *Strong (General)* 654
    - *Strong (Baryon No. = 0)* 656
    - *Strong (Baryon No. = 1)* 657
    - *Strong (Baryon No.* ≥ 2*)* 658
  - Particle Invariance Principles and Symmetries 659
    - *General* 659
    - *Applications (Electromagnetic and Weak)* 659
    - *Applications (Strong)* 659
  - Scattering Theory 659
- **PHYSICS (LOW-TEMPERATURE)** 662
  - Superfluidity 662
  - Superconductivity 662
  - Equipment and Devices 664
- **PHYSICS (NUCLEAR)** 666
  - Neutron Interactions with Matter 666
  - Nuclear Properties and Reactions, $A \leq 5$ 666
  - Nuclear Properties and Reactions, $6 \leq A \leq 19$ 667
  - Nuclear Properties and Reactions, $20 \leq A \leq 38$ 669
  - Nuclear Properties and Reactions, $39 \leq A \leq 58$ 669
  - Nuclear Properties and Reactions, $59 \leq A \leq 89$ 670
  - Nuclear Properties and Reactions, $90 \leq A \leq 149$ 671
  - Nuclear Properties and Reactions, $150 \leq A \leq 189$ 672
  - Nuclear Properties and Reactions, $190 \leq A \leq 219$ 674
  - Nuclear Properties and Reactions, $A \geq 220$ 674
  - Nuclear Theory 676

Category *Page*

- **PHYSICS (PLASMA AND THERMONUCLEAR)** 680
  - Confinement and Heating 680
  - Diagnostics 680
  - Kinetics (General) 681
  - Kinetics (Theoretical) 683
  - Production 684
  - Stability 684
  - Thermonuclear Engineering and Equipment 686
  - Wave Phenomena 687
- **PHYSICS (RADIATION AND SHIELDING)** 689
  - Radiation Physics 689
  - Radiation Protection Standards 690
  - Radiation Source Calibration and Standardization 690
  - Shielding Calculations and Experiments 690
- **PHYSICS (THEORETICAL)** 692
  - General 692
  - Quantum Field Theories 693
  - Gravitation and General Relativity 694
- **REACTOR TECHNOLOGY AND REGULATION** 696
  - Power Reactors, Non-Breeding, BWR-Type 696
  - Power Reactors, Non-Breeding, PWR-Type 697
  - Power Reactors, Non-Breeding, Graphite Moderated 699
  - Power Reactors, Non-Breeding, Otherwise Moderated 701
  - Power Reactors, Breeding 702
  - Research, Test, and Experimental Reactors 707
  - Production and Materials Testing and Processing Reactors 708
  - Propulsion and Package Reactors 708
  - Reactor Safety and Environmental Aspects 712
  - Reactor Theory and Calculation 714
  - Reactor Components and Accessories 724
  - Reactor Fuels 724
  - Reactor Control Systems 725
  - Nuclear Power Plant Economics 726
  - Reactor Fuel Cycle Economics 727
  - Reactor Licensing and Regulation 727
- **GENERAL** 731
  - Energy Utilization and Economics 731
  - Information Handling 731
  - Law 731
  - Management 731
  - Mathematics and Computers 732
  - Miscellaneous 733
- **CORPORATE INDEX** INDEX-1
- **PERSONAL AUTHOR INDEX** INDEX-14
- **SUBJECT INDEX** INDEX-81
- **REPORT NUMBER INDEX** INDEX-184

STAFF OF NUCLEAR SCIENCE ABSTRACTS

Editor and Production Manager
David E. Bost

Associate Editors
Everett J. Hoffman
John W. Norris
Lawrence T. Whitehead

Section Editors
M. Catherine Grissom
Robert C. Kelly
Henry D. Raleigh
Charles E. Stuber
Lee M. Thompson

Descriptive Cataloging Specialist
J. Paul Meredith

Subject Heading Specialist
Sidney F. Lanier

Corporate Author Specialist
Clara L. Fox

Report Number Specialist
Helen W. White

Evaluators
Thomas S. Chapman
John H. Mitchell
Mary H. Newman

Abstractors
E. Ray Bedford
Jane G. Buchanan
D. Lamar Cason
David C. Cunningham
Theodore F. Davis
James R. Dulaney
Helga B. Gerstner
Phyllis C. Hansen
Carolyn D. Houston
W. Hugh Kinser
Lisbeth C. Lieberman
William D. Matheny
Dora H. Moneyhun
Jean F. Peckham
Mona H. Raridon
Julia S. Redford
Jesse W. Rushing
Robert W. Rutkowski
Francis S. Sachs
Lila B. Smith
Polly C. Summers
Helen L. Ward
Kenneth S. Warren
Milton O. Whitson
Martha C. Wilson

Publishing Coordinator
Charles R. Bruce

Computer Processing Coordinator
Frederick E. Marsh

Communication concerning the editorial policy and content of *Nuclear Science Abstracts* should be addressed to the Editor, *Nuclear Science Abstracts*, USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

Use of funds for printing this publication approved by the Director of the Office of Management and Budget, June 19, 1972.

Volume 28, Number 3

August 15, 1973

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

5086 (TID-4068) RESEARCH AND DEVELOPMENT IN PROGRESS. Summaries of the USAEC Basic Research Program in Chemistry. (Division of Physical Research (AEC), Washington, D. C.). Jan 1973. 173p. Dep. NTIS $7.60.

Summaries of the current status and individual research efforts of projects being supported by the Office of Chemistry Programs of the Division of Physical Research are presented. The summaries are arranged in sections by discipline. Contractor index, principal investigator index, and subject index are also provided. (DHM)

Analytical and Separations Chemistry

Refer also to abstracts 5644, 5653, 5734, 7322, and 7626.

Activation and Nuclear Reaction Procedures

Refer also to abstracts 5433, 5564, 5717, 5870, and 7013.

5087 (AERE-PR/NP-18, pp 60-66) MISCELLANEOUS TECHNOLOGIES AND TECHNIQUES. Mar 1972.

5088 (CEA-CONF-2120) DETERMINATION OF IODINE BY ACTIVATION IN THE THYROID FOLLICLES. Riviere, R.; Camuzzini, G. F.; Girault, M.; Stulzaft, O.; Comar, D. (Commissariat a l'Energie Atomique, Orsay (France). 1971. 14p. (In French). (CONF-721010-29). Dep. NTIS (U. S. Sales Only).

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

After having performed an excision of human thyroid tissue, the follicles, which represent the functional parts of the thyroid gland, were dissociated by the action of collagenosis on the connecting tissue. The smallest follicles analyzed having diameters of less than 100 μ and weighing less than 0.5 μg contained quantities of iodine less than 0.5 ng. Activation analysis techniques enable micro-quantities of iodine to be determined in a satisfactory manner. Particular attention is given to the packing of the samples. (France)

5089 (CONF-721010-41) INVESTIGATIONS ON THE PREPARATION AND APPLICATION OF SOME INORGANIC SEPARATORS FOR THE REMOVAL OF THE MATRIX ACTIVITY IN NEUTRON ACTIVATED BIOLOGICAL SAMPLES. Nagy, L. G.; Toeroek, G.; Foti, G.; Toth, T.; Feuer, L. (Technical Univ. of Budapest (Hungary)). 1972. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The following inorganic separators were prepared for the selective removal of the matrix activity (^{24}Na, ^{32}P, and ^{42}K) from neutron activated biomedical samples: hydrated antimony pentoxide, zirconium phosphate, and titanium phosphate. Elution chromatographic techniques with the appropriate tracers were used to determine the sorption parameters of the samples. The basic principles of the sorption processes were investigated and the experimental conditions were optimized. The following trace elements: Mn, Co, Cu, Fe, and Zn were then determined in animal blood samples using these inorganic separators combined with a distillation procedure and an ion exchange separation process. (France)

5090 (CONF-721010-53) DETERMINATION OF MAJOR COMPONENTS AND TRACE ELEMENTS IN ANCIENT SILVER BY THERMAL NEUTRON ACTIVATION ANALYSIS. Meyers, P.; van Zelst, L.; Sayre, E. V. (Metropolitan Museum of Art, New York (USA)). 1972. 13p. Dep. NTIS $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Thermal neutron activation of minute samples of ancient silver objects has provided useful information concerning their silver, copper, and gold content. The results of such analysis of eighteen Sasanian silver objects are discussed together with consideration of the sampling problems involved. In order to extend these measurements to include other elements, an isotopic exchange system was developed to separate other activities present in irradiated silver specimens quantitatively from the silver, copper, and gold activities. Following exchange with cuprous and silver iodides it was possible to count quantitatively the activity of fourteen additional elements: As, Br, Cr, Fe, Hg, Ir, K, Mn, Na, Sb, Sc, Se, and Zn. (Fr)

5091 (CONF-721010-78) SUBSTOICHIOMETRIC DETERMINATION OF TRACE IMPURITIES IN HIGH-PURITY MATERIALS BY RADIOACTIVATION ANALYSIS. Kudo, K.; Shigematsu, T.; Iso, H. (Nippon Telegraph and Telephone Public Corp., Tokai (Japan). Ibaraki Electrical Communication Lab.). 1972. 8p. Dep. NTIS (U.S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A method of radioactivation analysis was developed for the determination of Ni, Mn, Cu, Au, Ag, Cd, and Zn impurities in GaAs and Se. All the components are separated by suitable procedures and determined by substoichiometric methods. Ni is extracted as the diethyldithiocarbamate in $CHCl_3$, Au as a complex of rhodamine-B in $CHCl_3$ and other elements as dithizonates in CCl_4 under the appropriate conditions. (France)

5092 (CONF-721069-31) APPLICATION OF SUBSTOICHIOMETRY TO RADIOACTIVATION ANALYSIS. Determination of Trace Impurities in High-Purity Materials. Kudo, K.; Suzuki, N. (Nippon Telegraph and Telephone Public Corp., Tokai (Japan). Ibaraki Electrical Communication Lab.; Tohoku Univ., Sendai (Japan)). 1972. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

From international colloquium on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

A new radioactivation analysis method based on substoichiometry is proposed. The method has the following advantages: corrections for the chemical yield are unnecessary, secondary nuclear reactions and self-shielding do not cause errors in the quantitative determination. The determination of trace impurities in high purity materials and semiconductor materials using two different techniques is described. (France)

5093 (CONF-721069-33) IMPURITY BEHAVIOR OF LIGHT ELEMENTS IN Si USED FOR MANUFACTURING SEMICONDUCTOR MATERIALS. Nozaki, T.; Yatsurugi, Y.; Akiyama, N.; Endo, Y.; Makide, Y. (Institute of Physical and Chemical Research, Wako (Japan)). 1972. 11p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

From international colloquium on the activation analysis of microquantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

Charged particle activation analysis was used to determine C, N, and O in Si used in the manufacture of semiconductor materials. The concentrations of these three elements, their solubilities at the

Si melting point, their equilibrium distribution coefficients, and their infrared absorption coefficients were measured. The behavior of the three elements in the production of Si for semiconductor materials was established from activation analysis measurements, infrared spectrophotometry, and a special tracer technique. (FR)

5094 (CONF-721069-35) ACTIVATION ANALYSIS OF IMPURITY DISTRIBUTIONS IN CRITICAL LAYERS OF SEMICONDUCTORS. Rausch, H.; Bereznai, T.; Bogancs, J. (Research Inst. for Telecommunication, Budapest (Hungary)). 1972. 7p. Dep. NTIS (U. S. Sales Only) $3.00.

From international colloquium on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

Investigations of epitaxial layers grown on arsenic, antimony, and phosphorus doped substrates are reported. Activation analysis and autoradiography were used for the study of the critical layers. The concentration distributions of the doping elements and the most frequent trace impurities, such as gold, copper, and sodium were determined in the superficial layer and in the film/substrate interface of the homoepitaxial silicon layers. Under the given experimental conditions, the minimum detectable contaminant concentration was found to be about 10^{13} atoms/cm^3. (France)

5095 (CONF-721069-49) SOME RESULTS OBTAINED IN SLOVAKIA IN THE DETERMINATION OF TRACE ELEMENTS BY NEUTRON ACTIVATION ANALYSIS. Tolgyessy, J.; Adamek, A.; Kliment, V.; Severa, F.; Sacha, J. (Slovak Technical Univ., Bratislava (Czechoslovakia). Dept. of Radiochemistry and Radiation Chemistry). 1972. 11p. Dep. NTIS (U.S. Sales Only) $3.00.

From international colloquium on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

Results obtained on the determination of trace elements by neutron activation performed at the Department of Radiochemistry and Radiation Chemistry of the Slovak Technical University and at the Institute of Physics of the Slovak Academy of Sciences (both in Bratislava) are presented. The activation was realized using a nuclear reactor and a neutron generator constructed in the laboratories. (Fr)

5096 (CONF-730434-1) STATUS REPORT: WHO/IAEA JOINT RESEARCH PROGRAMME ON TRACE ELEMENTS IN CARDIOVASCULAR DISEASES (AUTOPSY STUDIES: PROJECTS 1 AND 2. Parr, R. M. (International Atomic Energy Agency, Vienna (Austria)). 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

From meeting of investigators on trace elements in relation to cardiovascular diseases; Geneva, Switzerland (2 Apr 1973).

Data are presented on the content of Cd, Cu, Cr, Mo, Zn, and 18 other trace elements in autopsy samples of heart, kidney, and liver. Neutron activation analysis was used for the analyses in most cases although atomic absorption spectroscopy was also used. Comparisons were made of the results of various investigators. The data were further classified according to whether or not cardiovascular disease was known to be present. (ERB)

5097 (FRNC-CONF-67) MEASUREMENT OF THE THICKNESS OF OXIDE LAYERS BY IRRADIATION WITH 14 MeV NEUTRONS. Case of Al. Dugain, F.; Michaut, C. (Aluminium Pechiney, Voreppe (France). Centre de Recherches). 1972. 8p. (In French). (CONF-721010-9). Dep. NTIS (U.S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Neutron activation analysis (14-MeV neutrons) enabled the quantity of oxygen present in the surface of thin Al foils to be evaluated. The results coincide with those obtained by ellipsometry for 50 to 500A thick oxide layers. (Fr)

5098 (FRNC-CONF-74) DETERMINATION OF As, Se, AND Te IN S. Verot, J. L.; Jaumier, J. J. (Ugine-Kuhlmann, Levallois-Perret (France). Laboratoire Central de Recherches Produits Chimiques). 1972. 5p. (In French). (CONF-721069-20). Dep. NTIS (U.S. Sales Only) $3.00.

From international colloquium on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

Activation analysis can be used to determine simultaneously As, Se, and Te in S. After irradiation, the S is brought into contact with NaOH and CS_2. The analysis can be carried out in a routine manner for As, S, and Te concentrations in excess of 1 ppm. For smaller concentrations, chemical separation with carriers is necessary. (France)

5099 (FRNC-CONF-80) POSSIBLE INDUSTRIAL APPLICATIONS OF ^{252}Cf SOURCES IN ACTIVATION ANALYSIS. Verot, J. L. (Ugine-Kuhlmann, Levallois-Perret (France). Laboratoire Central de Recherches Produits Chimiques). 1972. 10p. (In French). (CONF-721069-38). Dep. NTIS (U.S. Sales Only) $3.00.

From international colloquium on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

The possibility of using ^{252}Cf for industrial determinations during production are considered. The cases of fluorine (macro-determination) and hafnium (trace determination) were studied. In these different problems, ^{252}Cf sources offer interesting possibilities. (France)

5100 (KFK–1790) SIMPLE DETERMINATION OF CHLORINE IN ORGANIC MATERIALS AND IN LOADED ACTIVATED CHARCOAL WATER FILTERS BY NEUTRON ACTIVATION ANALYSIS. Ruf, H.; Gantner, E.; von Baeckmann, A. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). Mar 1973. 14p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

Chlorine contents ranging from 20 ppM to 25% in organic substances, e. g. extracts of biological materials and activated coal were determined by neutron activation analysis without any chemical treatment. After irradiation times of only a few minutes, gamma activity of ^{38}Cl could be measured by means of a Ge(Li) detector short times after the end of irradiation, using the rabbit system connecting the institute with the FR 2 reactor. Polyethylene-capsules of high purity were used as wrapping-material for targets. (auth)

5101 (ORO–2401-60) RADIOISOTOPE STUDIES UTILIZING A LOW LEVEL WHOLE-BODY COUNTER AND CLINICAL APPLICATIONS OF ACTIVATION ANALYSIS. Progress Report, 1972–1973. (Vanderbilt Univ., Nashville, Tenn.). 1973. Contract AT(40-1)-2401. 47p. Dep. NTIS $4.50.

Progress is reported on studies in dosimetry and activation analysis. Studies on the determination of tracer doses of ^{58}Fe in blood plasma by neutron activation were continued. (JGB)

5102 DETERMINATION OF MERCURY IN MILK POWDER BY MEANS OF NEUTRON ACTIVATION. Heine, K.; Wiechen, A. (Bundesanstalt fuer Milchforschung, Kiel). Milchwissenschaft; 27: No. 11, 688-691(1972). (In German).

The increasing use of mercury in industry and agriculture has led to local environmental problems which, however, remain confined to aquatic systems so far. The main soil-produced foods are not yet contaminated by mercury. The present paper is concerned with mercury determinations in milk powders from the whole area of Federal Germany, the analyses being made by means of neutron activation. The Hg contents were found to range between 3 and 30 ppB and are in good agreement with values found for fresh milk ranging from 0.4 to 4 ppB which were published by Stock and coworkers as early as 1934. Apparently, the mercury content of milk has not increased during the past 40 yrs. (GE)

5103 COMPUTER PROGRAM FOR ANALYSIS OF γ SPECTRA FOR THE DETERMINATION OF TRACE ELEMENTS BY NEUTRON ACTIVATION. Heine, K.; Wiechen, A. (Bundesanstalt fuer Milchforschung, Kiel). Kiel. Milchwirt. Forschungsber.; 24: No. 4, 357-369(1972). (In German).

Many elements can quantitatively be determined by measurement of the induced activity of the sample. The program GAMA2 was written for the analysis of the digitized spectra read out by the multi-channel-analyzer on paper tape. GAMA2 selects peaks and their boundary channels on the left and right side by means of the smoothed first derivative of the spectrum. Peak areas are computed by summing up the spectrum between the boundary channels and subtracting the base area. This general routine for evaluation of peaks gives reliable results for isolated peaks. There are some restrictions, however, for interfering peaks. GAMA2 computes the concentration of one element by means of the peak areas. The computer program has run in routine analysis for some months. (GE)

5104 DETERMINATION OF ARSENIC IN TEA PLANT BY NEUTRON ACTIVATION ANALYSIS. Takeo, T. (Tea Research Station, Shizuoka, Japan); Shibuya, M. Nippon Shokuhin Kogyo Gakkaishi; 19: No. 2, 91-95(Feb 1972). (In Japanese).

The content of As in tea plant was determined by neutron activation analysis. The content of As could not be determined by nondestructive activation analysis, using a Ge(Li) γ spectrometer, because the γ peak of ^{76}As on the spectrogram is masked by the γ-ray peak of ^{82}Br that exists in tea and has a very similar γ spectrum. After destruction of the tea plant with acid, Br in tea plant was distilled off from the acid treated solution and the γ-ray peak of ^{76}As was evidenced on the γ spectrogram of the acid treated solution. From the height of the γ peak of ^{76}As, the contents of more than 0.2 μg of As in tea plant were determined quantitatively. By using the Gutziet method, as in tea plants was separated from other elements and two characteristic γ peaks of ^{76}As were figured on the γ spectrogram. From these spectrograms, more than 0.05 μg of As in tea plants were detected quantitatively. (auth)

5105 ACTIVATION ANALYSIS OF HUMAN HEAD HAIR. VII. Characteristics of Trace Elements in Japanese Head Hair. Kozuka, H. (National Research Inst. of Police Science, Tokyo); Isono, H.; Tsunoda, N.; Niwase, T. Eisei Kagaku; 18: No. 1, 1-6(Feb 1972). (In Japanese).

As a representative sample of the Japanese population, 996 samples of head hair were collected in 1967. Using nondestructive activation analysis, the concentration of Al, Cl, Na, Br, Mn, Cu, Hg, Zn, and Au was determined and their histograms showing the relation between concentration and frequency were established. The distribution histograms were analogous to the so called lognormal type, except Zn and Hg, and converted to the normal type distribution by the logarithmic conversion of the scale of concentration. The concentration of mercury in the samples ranged from 1 to 13 ppM and only one sample showed a very high concentration of 47 ppM. The averages, excluding this exception, were 5.42 ppM for males, 4.62 ppM for females, and 5.02 for total. The correlations among the trace elements were not markedly high and it is considered that the elements exist independent of each other. The highest correlation was recognized between Na and Cl. The concentration of trace elements in Japanese human head hair was generally low compared with data on other races reported by several workers. Three elements, Hg, Br, and Mn, showed slightly higher concentration and were characteristic to Japanese hair. (auth)

5106 ACTIVATION OF TRACE ELEMENTS BY NUCLEAR PARTICLES AND DETERMINATION BY GAMMA SPECTROMETRY OF THE RADIOISOTOPES FORMED. Haerdi, W. (Univ., Geneva). Mitt. Geb. Lebensmittelunters. Hyg.; 63: No. 2, 223-229(1972). (In French)

Activation analysis with the use of neutrons or of charged nuclear particles is reviewed. Activation by charged particles is recommended for the determination of elements of low atomic wt., e.g., B, C, N, O, and F, particularly when neutron activation is unsuitable and other methods are slow or insufficiently sensitive. Applications to the analysis of, e.g., metals, oils, and drugs are cited. (20 references) (Anal. Abstr.)

5107 NEUTRON ACTIVATION ANALYSIS OF TRACE METALS IN RICE BRAN OIL. Determination of Manganese and Copper. Park, T. W.; Kim, T. Y. Hwahak Konghak; 9: No. 4, 191-195(1971).

With the object of checking the stability of domestic rice bran oil, manganese and copper in trace amounts were analyzed by neutron activation analysis. Manganese was determined by a nondestructive method after it was irradiated at the pneumatic tube (neutron flux 3.4×10^{12} n cm^{-2} sec^{-1}) of the TRIGA MARK II reactor 10 min. and copper by a destructive method that uses an anion exchange resin to concentrate copper after irradiation for 1 hr. The manganese and copper contents (along with the respective experimental standard deviations) of dewaxed crude oil, deacidified oil, bleached oil and deodorized oil, sampled from each process of one batch processing, were 13.4 ± 0.4, 2.6 ± 0.2, 0.24 ± 0.01, and 0.33 ± 0.03 and 0.24 ± 0.03, 0.21 ± 0.03, 0.056 ± 0.007, and 0.040 ± 0.002, respectively. The content of manganese in domestic rice bran oil compared with that of a foreign product is extraordinarily high, while the copper content seems to be in a similar level as the content of foreign products. (Korean Sci. Abstr.)

5108 SEPARATION OF PALLADIUM TRACES FROM VERY PURE PLATINUM AFTER NEUTRON ACTIVATION WITH REGARD TO ADDITIONAL TRACE CONTAMINANTS. Matthes, W.; Stoeppler, M. (Kernforschungsanlage, Juelich, Ger.). Z. Anal. Chem.; 264: No. 3, 181-184(1973). (In German).

From first European conference on analytical chemistry; Heidelberg, Germany (28 Aug 1972).

The separation of ^{109}Pd ($T_{½}$ = 13.5 h) after neutron activation from the highly radioactive platinum is performed after addition of Pd carrier as chloro-complex on strong basic anion-exchangers. The simultaneous separation of some further short living radionuclides of trace element takes place. After a purification step with dimethylglyoxime decontamination factors up to 10^6 are attainable. Using a Ge(Li)-detector and evaluating the γ-irradiation of the ^{109}Pd daughter ^{109}Ag, 0.4 μg of Pd could be determined with a standard deviation of 6.5%. (GE)

5109 ACTIVATION ANALYSIS OF RARE EARTH MINERAL RAW MATERIALS BY USING A (Ge–Li)-DETECTOR. Lobanov, E. M.; Abdurakhmanova, S. R.; Berestovoi, A. M. (Inst. of Physics of Solids and Semiconductors, Minsk). Zh. Anal. Khim.; 28: No. 4, 813-815(Apr 1973). (In Russian).

The use of a Ge(Li)-spectrometer for the activation analysis of rare earth mineral raw materials was studied. It was shown that the resolution of a 5 KeV spectrometer by E = 122 KeV is sufficient for simultaneous determination of Sm, Eu, and La in minerals (monazite, rinkolite, pyrochlore). (auth)

5110 NEUTRON-ACTIVATION DETERMINATION OF IMPURITIES IN ANTIMONY USING EXTRACTION CHROMATOGRAPHY. Shchulepnikov, M. N.; Shmanenkova, G. I.; Shchelkova, V. P. Yakovlev, Yu. V. (State Scientific-Research and Design Inst. of Rare Metal Industry, Moscow). Zh. Anal. Khim.; 28: No. 3, 608-611 (Mar 1973). (In Russian).

An extraction-chromatographic method was developed for separation of Cr, Mn, Co, Ni, Cu, and Zn from Sb with the decontamination coefficient of not less than 10^9. A method of neutron-activation analysis of Sb using extraction chromatography is suggested. (auth)

5111 DETERMINATION OF OXYGEN IN INDIUM BY THE GAMMA ACTIVATION ANALYSIS WITH RADIOCHEMICAL ISOLATION OF ^{15}O ISOTOPE. Vasserman, A. M.; Kunin, L. L.; Kapitsa, S. P. Samosyuk, V. N. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 28: No. 4, 729-735(Apr 1973). (In Russian).

A radioactivation method was developed for determining oxygen in pure indium with the sensitivity of about 2×10^{-5}% and the accuracy of about 30% (at oxygen concentration of about 10^{-4}%). The method is based on the (γ,n) reaction with radiochemical isolation of the short-lived isotope of ^{15}O. The 30 MeV microthrone of the Institute of Physical Problems was used as a source of the braking radiation. The accuracy of the method was confirmed by the comparison of its results with those obtained by the reduction-fusion method. (auth)

5112 ACTIVATION ANALYSIS OF THE URANIUM AND THORIUM CONTENT AND THEIR MIXTURES BY A METHOD OF RECORDING DELAYED NEUTRONS. Dzhordzh, E. T.; Al'Abbasi, M. A.; Al'Shakhiri, G. Yu.; Borisov, G. I.; Dikarev, V. S. pp 15-23 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5113 USE OF THE Ge(Li) DETECTOR FOR NEUTRON ACTIVATION ANALYSIS OF SHORT-LIVED ISOTOPES. Al'-Shakhristani, Kh. I.; Borisov, G. I. pp 24-27 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5114 DETERMINATION OF THE SILVER CONTENT BY THE SHORT-LIVED ISOMER ^{110}Ag IN A PNEUMATIC RABBIT IN THE WWRK REACTOR WITH THE USE OF A Ge(Li) SPECTROMETER. Burmistrov, V. R.; Shilin, V. A. pp 33-42 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5115 USE OF A SEMICONDUCTOR Ge(Li) SPECTROMETER FOR THE INSTRUMENTAL DETERMINATION OF THE RHENIUM CONTENT IN NEUTRON ACTIVATION ANALYSIS. Kiselev, B. G.; Burmistrov, V. R. pp 43-49 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5116 DETERMINATION OF GOLD AND ACCOMPANYING ELEMENTS IN ORES AND CONCENTRATES BY MEANS OF PHOTOACTIVATION METHOD. Shkoda–Ul'yanov, V. A.; Yakovlev, B. M.; Khasanov, V. Kh.; Lomonosov, V. I.; Mazur, V. M. pp 50-53 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5117 ACTIVATION ANALYSIS OF MERCURY CONTENT IN ROCKS AND ORES USING INELASTIC SCATTERING OF γ RADIATION. Shkoda–Ul'yanov, V. A.; Yakovlev, B. M.; Khasanov, V. Kh.; Lomonosov, V. I. pp 54-56 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5118 CALCULATION OF THE VARIATION OF THE NUCLEAR REACTION CROSS SECTION WITH THICKNESS OF THE IRRADIATED MEDIUM IN ACTIVATION ANALYSIS BY CHARGED PARTICLES. Mazitov, B. S.; Muminov, V. A.; Mukhammedov, S.; Sultanov, B. pp 57-61 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5119 DETERMINATION OF OXYGEN AND NITROGEN CONTENT BY MEANS OF THE (p,α) REACTION IN A CYCLOTRON. Mazitov, B. S.; Muminov, V. A.; Mukhammedov, S.; Sultanov, B. pp 62-67 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5120 SENSITIVITY FOR THE DETERMINATION OF VARIOUS ELEMENTS BY A NEUTRON ACTIVATION METHOD USING Ge(Li) DETECTORS. Sukhov, G. V.; Firsov, V. I. pp 68-74 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5121 DETERMINATION OF SOME COMPONENTS OF ALLOYED STEEL BY A NEUTRON ACTIVATION METHOD. Egorov, Yu. S.; Kochevanov, V. A.; Leont'ev, G. G.; Moskvin, L. N.; Tomilov, S. B. pp 75-80 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5122 NEUTRON ACTIVATION ANALYSIS OF ELEMENTS IN BIOLOGICAL SPECIMENS. Demidov, A. M.; Tarykchieva, N. K. pp 81-82 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5123 NEUTRON ACTIVATION ANALYSIS OF FLOWING SOLUTIONS WITH A CHERENKOV DETECTOR. Kartashev, E. R.; Chulkin, V. L.; Shtan, A. S. pp 86-90 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5124 ACTIVATION OF DIFFERENT TYPES OF ROCK BY NEUTRONS. Blinov, V. A.; Gavrilov, V. M.; Gedeonov, L. I.; Egorov, Yu. S.; Krivokhatskii, A. S.; Savonenkov, V. G.; Skirda, N. V. pp 270-290 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5125 CHARACTERIZATION OF MEDIEVAL WINDOW GLASS BY NEUTRON ACTIVATION ANALYSIS. Olin, J. S.; Thompson, B. A.; Sayre, E. V. (Smithsonian Institution, Washington, DC). Develop. Appl. Spectrosc.; 10: 33-55(1972).

From 10th national meeting of the Society for Applied Spectroscopy and the 22 Annual Mid-America Spectroscopy symposium; St. Louis, Missouri, USA (18 Oct 1971).

See CONF-711073–.

A study is described that was undertaken to determine whether neutron activation analysis could be useful in the characterization of medieval window glass. Analysis of the γ spectra from activated samples permits the determination of the major constituents sodium, potassium, calcium, aluminum, and manganese. Vanadium and indium were also observed if present in sufficient concentration. Larger samples (50 to 100 mg) were irradiated for 15 min to 1 hr and allowed to decay for 1 to 2 weeks after which concentrations of minor and trace constituents were determined. It was concluded that the heterogeneity of medieval glass in general and the homogeneity of the panel discussed argue favorably for the possibility of characterizing glasses of a given provenance on the basis of the composition data gained by neutron activation analysis. (DHM)

5126 NUCLEAR PARTICLE SPECTROSCOPY: APPLICATIONS OF NEUTRON ACTIVATION ANALYSIS AND GAMMA-RAY SPECTROSCOPY IN BIOMEDICINE. McKown, D. M.; Vogt, J. R. (Univ. of Missouri, Columbia). Develop. Appl. Spectrosc.; 10: 247-258(1972).

From 10th national meeting of the Society for Applied Spectroscopy and the 22nd Annual Mid-America Spectroscopy symposium; St. Louis, Missouri, USA (18 Oct 1971).

See CONF-711073–.

Some biomedical applications of analytical techniques utilizing γ spectroscopy are reviewed including determination of trace elements by neutron activation analysis, radioisotope tracer techniques, and stable isotope techniques. (DHM)

5127 RAPID DETERMINATION OF VERY LOW NITROGEN LEVELS IN WATER. Bankert, S. F.; Bloom, S. D.; Dietrich, F. S. (Univ. of California, Livermore). Nature (London); 242: No. 5395, 270-271(23 Mar 1973).

A new approach to ^{14}N assay, applicable to the evaporated ecosystem detritus of <4 ml of water, is described. The present overall accuracy is about ±25% at concentrations $>200 \times 10^{-9}$ g/kg, and the test is sensitive down to levels of $\sim 20 \times 10^{-9}$ g/kg. The time per sample is ~3 min and the sample is not destroyed. The method employs charged particle activation analysis according to the reactions (a) $^{14}N + p \rightarrow {}^{14}O + n$ and (b) $^{14}O \rightarrow {}^{14}N + \gamma + e^+$. N is measured by counting the number of 2.31 MeV γ-rays from reaction (b). Activation may be produced by a 1 μA beam of 8 MeV protons from a cyclotron, and the γ rays are detected with a NaI scintillator following rapid transfer of the target to the counting location. After 5 to 10 min decay the sample can be retested. The method is insensitive to volatilized N_2. Full details of the technique are given, including improvements, together with results for a number of different water sources from Northern California and Colorado. (UK)

5128 RARE EARTHS, OTHER TRACE ELEMENTS, AND IRON IN LUNA 20 SAMPLES. Helmke, P. A.; Blanchard, D. P.; Jacobs, J. W.; Haskin, L.; Haskin, A. (Univ. of Wisconsin, Madison). Geochim. Cosmochim. Acta; 37: No. 4, 869-874(Apr 1973).

The concentrations of the following 23 elements were determined in six small samples of material collected by the Luna 20 mission: La, Ce, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Yb, Lu, Co, Sc, Hf, Zn, Cr, Ga, Rb, Cs, Ni, Fe, and Mn. The results of the analysis by neutron activation of these samples, and of one sample of <1 mm fines from Apollo 16, are reported. The concentrations of the rare-earth elements (REE) in the samples of fines from Luna 20 and Apollo 16 are less than those found for corresponding materials from the mare areas but a negative Eu anomaly is still present. The concentrations of the REE in fines from Luna 20 are only about two-thirds as great as in the sample of Apollo 16 fines, but the concentrations of Co, Sc, and Cr are greater by factors ranging from 1.5 to 2.3. (auth)

5129 MODIFIED GENERALIZED STRIPPING TECHNIQUE FOR THE ANALYSIS OF COMPLEX GAMMA SPECTRA GENERATED IN NEUTRON ACTIVATION ANALYSIS. Citrenbaum, G. M. Blacksburg, VA; Virginia Polytechnic Inst. and State Univ. (1973). 165p. University Microfilms Order No. 73-11,615. Thesis (Ph.D.).

A pair of programs were developed to aid in the activation analysis of complex gamma-ray spectra obtained on lithium-ion drifted germanium detectors. The first program, SPC, is a nonlinear routine which locates peaks, fits the peaks to a theoretical curve, and, when the detector and counting system characteristics are known, decomposes complex groupings of peaks into their singlet components. The second program, SRP, is a modified and generalized version of the spectrum stripping technique which, by comparison of an unknown spectrum with a library created by the operation of SPC on known spectra, performs a quantitative decomposition of the unknown spectrum into a summation of preselected events of its component spectra. The use and capabilities of both programs are discussed, and listings of the programs as well as of the comprehensive library employed by SRP are provided in an Appendix. (Diss. Abstr. Int., B)

5130 DETERMINATION OF ^{18}O CAROTENOIDS BY MEANS OF 5 MeV-PROTON ACTIVATION. Weigel, H.; Heimann, M.; Johannes, B. (Univ., Cologne). (1972). vp. (In German).

From meeting: nuclear medicine and radiochemistry; Freiburg i. B., Germany (27 Sep 1972).

The $^{18}O(p,n)^{18}F$ nuclear reaction was used for the determination of the ^{18}O isotope ratio to throw light on the mechanism of the observed light-induced de-epoxidation of carotenoid epoxides and its reversibility in the dark, ^{18}O-labeled compounds were used in the experiments. The question of isotope exchange of the oxygen of the epoxide with the oxygen of water was of special interest. According to the results, the oxygen isotope exchange does not carry great weight. The described method allows the determination of ^{18}O in the ng region. (GE)

5131 IS RADIOCHEMISTRY THE ULTIMATE IN TRACE ANALYSIS? Meinke, W. W. (National Bureau of Standards, Washington, DC). Pure Appl. Chem.; 34: No. 1, 93-104(1973).

The advantages and disadvantages of activation analysis as well as of several other types of radiochemical methods are discussed in relation to other trace analysis techniques, such as spectrophotometry, flame emission spectroscopy, and polarography. Experience at NBS in certifying trace element Standard Reference Materials in matrices as diverse as glass, orchard leaves, gold, zinc, beef liver, tuna fish, and coal has given an insight into the optimum contributions which can be made by many of these methods. It is stated that it is at the 1 ppM level that activation analysis begins to make a major contribution, and when used in combination with radiochemistry the problem of reagent blank is eliminated. In considering values for accuracy determinations on samples such as the 1 ppM glass, it is found that when isotope dilution mass spectrometry can make the measurement it will be accepted as a referee-type method if results can be obtained from two different laboratories. The usefulness of the radiochemical method of activation analysis at the 0.02 ppM level of glass is discussed. Reference is made to the use of nuclear track counting to determine uranium and boron in a sample of lunar material. (UK)

5132 APPLICATION OF ACTIVATION ANALYSIS IN MEDICINE. Kasperek, K. (Kernforschungsanlage, Juelich, Ger.). (1972). vp. (In German).

From meeting: nuclear medicine and radiochemistry; Freiburg i. G., Germany (27 Sep 1972).

A survey is given on the application of activation analysis to the determination of trace elements in organ samples. Following a general introduction into the techniques of analysis and the importance of trace elements in the living organism, some examples of the application are given: blood serum studies (importance of stable tracers), tissue studies of different organs, tumor and brain tissue, further studies in toxicology, forensic medicine, occupational medicine, and environmental protection. Not only the absolute concentrations of trace elements but also the importance of trace element dynamics is taken up. (GE)

5133 ACTIVATION ANALYSIS OF TRACE ELEMENTS IN HUMAN BRAIN TUMORS REMOVED BY OPERATION. Relations to Density and Size of Cells. Schicha, H. (Kernforschungsanlage, Juelich, Ger.); Kasparek, K.; Vyska, K.; Mueller, W.; Schroeder, R. (1972). vp. (In German).

From meeting: nuclear medicine and radiochemistry; Freiburg i. B., Germany (27 Sep 1972).

In 78 human tissue samples that were taken during brain operations—mostly tumor tissue—Co, Se, Zn, Rb, and Fe were determined by activation analysis. Between Se and Zn, but also between Se and Rb as well as Fe, significant correlations exist that are markedly different in gliomatous tumor tissue compared to normal brain tissue. In relating the single element concentrations to histologically determined cell densities, one obtains similar correlations of these five essential elements with concentrations increasing with increasing cell density. In addition the single-cell size seems to be of importance. The results show that not the absolute concentrations of the essential trace elements but deviations of the element correlations between each other reflect the function-dependent deviations from the standard. (GE)

5134 SENSITIVITY LIST FOR MULTI-ELEMENT PHOTON ACTIVATION ANALYSIS USING 30 MeV BREMSSTRAHLUNG. Kato, T. (Tohoku Univ., Sendai). Kakuriken Kenkyu Hokoku; 5: No. 2, 137-147(Dec 1972).

Photon activation products and their gamma-ray photopeak activities were tabulated for the interpretation of spectral data in multi-element photon activation analysis using high-resolution gamma-spectrometry. The table includes activity data for the gamma-rays emitted by essentially all of the product nuclides found in 71 elements, from carbon up to bismuth, with ~2 min as the lower half-life limit for detection with 30 MeV bremsstrahlung. Sensitivities were calculated based on the minimum detectable photopeak areas and listed in ascending order of gamma-ray energies. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 5253 and 5393.

5135 (CONF-730402-(P1-2), pp 799-812) CATHODE-RAY EXCITED EMISSION (CREE) SPECTROSCOPIC ANALYSIS OF TRACE RARE EARTHS. Larach, S. (RCA Labs., Princeton, NJ). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Cathodoluminescence gives a means of exciting f–f luminescence. It is most advantageous to use demountable cathode-ray equipment, and Y_2O_3 or ZnS are used as matrixes for comparison standards. The stick spectra of rare earths in Y_2O_3 and ZnS are shown. Several examples are given of CREE analysis used for quantitative determination of trace rare earths: Eu in Y_2O_3 and Gd_2O_3, and Tm in ZnS. Detection limits are 0.1 ppM in Y_2O_3 (0.005 ppM can be reached in Gd_2O_3) for Eu and 0.01 ppB for Tm. (3 tables, 6 figures, 9 references) (DLC)

5136 (CONF-730402-(P1-2), pp 1056-1067) ANALYSES OF RARE EARTH OXIDES USED IN PREPARATION OF STANDARD SOLUTIONS. Long Den Nguyen (Institut de Physique Nucleaire, Orsay, France); de Saint Simon, M.; Foex, M.; Coutures, J. P.; Gerdanian, P. 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Thermal balance analyses were made on the oxides of 10 elements: La, Ce, Nd, Sm, Eu, Gd, Dy, Er, Yb, and Lu. Considerable losses (5 to 15%) were observed for light elements except Ce; the loss was less than 1% for Ce and the heavy elements. Thermal balance and microbalance measurements were in good agreement. Results show the existence of anionic impurities in the lanthanide sesquioxides. (DLC)

5137 (CONF-730402-(P1-2), pp 1080-1090) SPECTROFLUORIMETRIC DETERMINATION OF RARE EARTHS IN URANIUM AFTER SEPARATION AND CONCENTRATION OF TOTAL LANTHANIDES ONTO AN ALUMINA COLUMN. Cazotti, R. I.; Abrao, A. (Instituto Energia Atomica, Sao Paulo, Brazil). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

A method is proposed for the determination of micro amounts of rare earths in U. The method includes a chromatographic separation on an alumina column and a fluorimetric determination of the individual rare earths. The method is applicable to Ce, Pr, Sm, Eu, Gd, Tb, Dy, Ho, Er, and Tm. (17 figures, 37 references) (DLC)

5138 (GAT-T-2040/Ths) TERNARY VAPOR-LIQUID EQUILIBRIA PREDICTED FROM THE BINARY SYSTEM DATA UF_6–HF, UF_6–F114, HF–F114. Slough, R. J. (Goodyear Atomic Corp., Piketon, Ohio). 2 Apr 1973. Contract AT(33-2)-1. 68p. Dep. NTIS $5.50.

Thesis. Submitted to Univ. of Ohio, Athens.

A model of the ternary vapor–liquid system UF_6–HF–F114 was created from the 3 binary component systems to determine if a bias in purity analysis could be caused by improper liquid UF_6 sampling. Limited binary component data required the use of both liquid–liquid solubility data and vapor–liquid equilibria data to generate activity coefficients. Van Laar, Margules, Scatchard Hamer, Wilson, Heil and NRTL equations were used to extend the experimental activity coefficient data. The best data fits were obtained by the NRTL in the HF–F114 and UF_6–HF systems. The Scatchard Hamer equations gave the best UF_6–F114 system fit. By use of the generalized multi-component equation of Chien and Null, the NRTL and Scatchard Hamer equations were combined into a Wang 720 C Program to give the ternary system model. The specific system of approximately 99% of theoretical pure UF_6, common to the gaseous diffusions industry, was studied at 198°F. The model gives results which are in reasonable agreement with experimental data. It appears that no detectable bias exists in the UF_6 sampling as all the volatile contaminants enter and remain in the vapor phase during the sampling at the conditions of low concentrations and high temperatures. (auth)

5139 (IAEA-R-881-F) COULOMETRIC DETERMINATION OF PLUTONIUM IN SOME SOLID PRODUCTS AND SOLUTIONS. Final Report for the Period 1 January 1970–31 December 1970. Markov, V. K. (International Atomic Energy Agency, Vienna (Austria)). Feb 1971. 15p. (In Russian). INIS.

Controlled potential coulometry was used to determine the true redox potentials for the PuO_2^{2+}/Pu_2^{+} pair in 0.5–1.5MH_2SO_4 and for the Pu^{4+}/Pu^{3+} pair in sulphate-phosphate media. The optimum conditions for titration of Pu(VI) to Pu(IV) by electrically generated Fe(III) ions were found. A method of dissolving PuO_2 in $HClO_4$ + HNO_3 and $HClO_4$ + HNO_3 + HF mixtures was proposed. It was shown that the disintegration products of $HClO_4$ (chlorine and its oxides) which interfere with the plutonium determination can be eliminated from the solution by the action of sulphosalicylic acid. The authors have proposed a method of coulometric titration of Pu(VI) to Pu(IV) by electrically generated Fe(II) ions with an amperometric system to show the end point of titration. The method makes it possible to obtain accurate and easily reproducible results from determinations of plutonium in dioxides, tetrahclorides and other compounds (the coefficient of variation does not exceed 0.2% rel. if 1 to 3 mg of plutonium are taken for titration). (INIS)

5140 (JEN-255) DETERMINATION OF CARBON IN URANIUM AND ITS COMPOUNDS. Perez Garcia, M. (Junta de Energia Nuclear, Madrid (Spain). Division de Quimica). 1972. 33p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.75.

Analytical methods used for the determination of carbon in uranium metal, uranate salts and the oxides, fluorides and carbides of uranium are reviewed. The carbon is usually burned off in an induction or resistance oven under oxygen flow. The CO_2 is collected in barite solution, where it is back-titrated with potassium biphthalate. (auth)

5141 (KY-648) DETERMINATION OF NITROGEN IN URANIUM HEXAFLUORIDE. Morgan, S. C.; Simmons, R. E. (Paducah Gaseous Diffusion Plant, Ky.). 18 Apr 1973. Contract W-7405-eng-26. 12p. Dep. NTIS $4.00.

A detailed procedure for determining inorganic nitrogen in uranium hexafluoride is given. Evidence is presented which demonstrates the method is effective for determining nitrogen present in the form of compounds such as nitrosylium and nitrylium hexafluorouranate and nitrosylium and nitrylium heptafluorouranate. Nitrogen in hydrolyzed uranium hexafluoride is converted to ammonia by reduction with Devarda's alloy. After separation by distillation the ammonia is measured titrimetrically or spectrophotometrically depending upon the concentration level. Using a 10 gram sample the precision of the method is ±18% for a single determination at the 95% confidence level for uranium hexafluoride containing 5 ppM nitrogen. The lower detection limit of the method is about 1 ppM nitrogen. (auth)

5142 (UCRL-Trans-10666) USE OF TWO-STEP FLOW COULOMETRY FOR FAST CONCENTRATION AND DETERMINATION OF MICROSCOPIC QUANTITIES OF METAL IONS. Kihara, S.; Motojima, K.; Fujinaga, T. Translated for Univ. of California, Lawrence Livermore Lab., Livermore, from Jap. Anal.; 21: 883-890(1972). 20p. Dep. NTIS.

A rapid method was developed for the concentration, separation, and determination of various metal ions by two-step flow-coulometry. Microamounts (2×10^{-7} moles) of Cd, Pb, and Cu ions were concentrated and determined from 10 l of aqueous solution containing 10^{-3} M uranium. The flow rate of the supporting electrolyte is controlled to 10 ml/min for concentration and 2 ml/min for separation and determination. (DHM)

5143 ANALYTICAL APPLICATIONS OF IRON(II) AS REDUCING AGENT IN PRESENCE OF EDTA: DETERMINATION OF IODINE. Sierra Jimenez, F.; Sanchez-Pedreno, C.; Perez Ruiz, T.; Martinez Lozano, C. (Univ., Murcia, Spain). An. Quim.; 68: No. 7-8, 999-1004(1972). (In Spanish).

The sample solution is treated with 0.1N-EDTA (10 ml), acetic acid-Na acetate buffer solution of pH 5.2 (10 ml), KI (3g), and H_2O to 50 ml and is then titrated, under N, with 0.02N-$(NH_4)_2SO_4 \cdot FeSO_4$ amperometrically (potential between electrodes = 60 mV), potentiometrically (platinum and calomel electrodes), or bipotentiometrically (platinum electrodes). Similar procedures can be used for indirect determination of, e.g., $Cr_2O_7^{2-}$ or IO_3^- by treatment with KI-KCl. The method can be used in the range 10 mM to 10 μM-iodine. (Anal. Abstr.)

5144 COMPARATIVE STUDIES ON THE METHODS OF IODINE DETERMINATION IN [SWIMMING POOL] WATER. Kelus, J. (State Inst. of Hygiene, Warsaw). Rocz. Panstw. Zakl. Hig.; 23: No. 4, 477-486(1972). (In Polish).

Several methods are reviewed, but only that of Black and Whittle (Analyt. Abstr., 1968, 15, 6336) is recommended. A modified version of this method, based on the colorimetric determination of free Br, gives accurate results even in the presence of free Cl though Mn(IV) interferes. (Anal. Abstr.)

5145 EFFECT OF ALKALI ELEMENTS ON THE AXIAL DISTRIBUTION OF LINE INTENSITY IN HIGH VOLTAGE ARC PLASMA. Role of Cesium for Improving Sensitivity and Precision in Spectrometric Analysis of Rare Earth Oxides. Osumi, Y.; Miyake, Y. (Government Industrial Research Inst., Osaka). Z. Anal. Chem.; 264: No. 1, 8-15(1973).

The effects of alkali elements on the axial distribution of the line intensity in plasma of high voltage spark were investigated, and the role of cesium to achieve optimum sensitivity and good precision in the spark excitation-spectrometric analysis of rare earth oxides incorporating a rotating electrode was explained. Addition of cesium to the discharge column affected the axial distribution of the intensity of the atomic and ionic lines in the discharge gap and caused an increase of the line intensity in the central region of the discharge gap. These phenomena are interpreted by the ionization pinch effect and variation in the ionization degree. The limits of detection for rare earths and diverse other elements in rare earth oxides were improved by the addition of cesium into the sample solution. Thus, microquantities of the elements within limits of detection from 1 to 25 ppM in neodymium oxide and europium oxide can be determined. The coefficients of variation are less than 13%. (GE)

5146 DETERMINATION OF ZIRCONIUM IN HIGH-ALLOY STEELS. Blazejak-Ditges, D. (Mannesmann-Forschungsinstitut GmbH, Duisburg, Ger.). Arch. Eisenhuettenw.; 43: No. 12, 887-888(1972). (In German).

A survey on the methods of determination of Zr in steels described in the literature with their particular complications is given. The experiments of the author using a photometric determination of Zr with arsenazo III are described and the suitability of this method as a function of Zr contents as well as of interfering alloy contents is discussed. The method is shown to be applicable to Zr contents from 0.002 to 0.5% without any preseparation procedure. (GE)

5147 COLORIMETRIC DETERMINATION OF MOLYBDENUM SEPARATED BY ION EXCHANGE FROM SPENT Co-Mo-Al CATALYST. Oprescu, C.; Leizerovici, E.; Cioloca, D. Rev. Chim. (Bucharest); 23: No. 12, 259-261(Dec 1972). (In Rumanian).

In view of the large cost of the components, recovery of spent Co-Mo-Al catalysts containing 7.4 to 8% Mo and 2.4 to 3.25% Co is of great economic importance. An ion exchange method was developed, using the strongly alkaline Daction AT-4 resin, yielding chloro complexes of Co and Mo. The Mo was determined in these highly acid solutions in the presence of traces of Fe and Co by means of a photocolorimetric method, using hydrazine sulfate to reduce the molybdenum. The sensitivity of the method was 10 γ; the coloration obtained was found to remain stable for more than 6 hours and followed the Lambert-Beer law. The experimental error was of the order of that usually encountered in microanalysis. The 2% hydrazine sulfate solutions were used in a hydrazine sulfate to molybdenum ratio of $^1/_1 \times 10^{-4}$ to $^1/_2 \times 10^{-4}$ by weight. (TTT)

5148 CHEMICAL PROPERTIES AND ANALYSIS OF REFRACTORY COMPOUNDS. Samsonov, G. V. (ed.). New York; Plenum Publishing Corporation (1972). 132p. $22.50.

Translation of Khimicheskie Svoistva i Metody Analiza Tugoplavkikh Soedinenii by G. D. Archard.

Results of various investigations into the chemical properties of refractory compounds and refractory-base alloys used in various fields of modern technology are reviewed together with original methods of analysis. (auth)

5149 DEVICE FOR AMPEROMETRIC TITRATION. Markhabaev, I. A.; Zhdanov, A. K. (Tashkent State Univ.). Uzb. Khim. Zh.; No. 5, 8-10(1972). (In Russian).

A simple, compact, portable instrument for amperometric titration is described. Typical titrimetric results are presented for the amperometric and biamperometric determinations of Er, Gd, Yb, and Lu. (tr-auth)

5150 INORGANIC TITRIMETRIC ANALYSIS. Contemporary Methods. Wagner, W.; Hull, C. J. Treatise on Titrimetry, Volume 1. New York; Marcel Dekker, Inc. (1971). 237p. $14.75.

The book provides the practicing chemist with a rapid handy, up-to-date guide to modern titrimetric methods. Sufficient practical information is given for the reader to determine whether a given method of titrimetric analysis suits his needs in terms of applicability, specificity, precision, and accuracy as well as the required reagents and instruments. Chapters are arranged according to the sequence of elements in the periodic table. Sections devoted to each element have been organized to include a concise discussion of the methods available; a brief survey of applicable earlier and contemporary titrimetric methods; a short description of the recommended contemporary methods; and a selective bibliography of post-1960 methods of titrimetric analysis. (DHM)

5151 RELATIVE SENSITIVITY COEFFICIENTS FOR RARE EARTHS IN SPARK-SOURCE MASS SPECTROMETRY. Conzemius, R. J.; Svec, H. J. (Ames Lab., IA). Talanta; 20: No. 6 575-583(Jun 1973).

Relative sensitivity coefficients were computed for rare earth elements Y, La, Ce, Pr, Nd, Sm, Eu, Gd, Th, Dy, Ho, Er, Tm, Yb, and Lu, according to empirical models which have been proposed in the literature. Explanations concerning differences between the computed and observed values are based upon possible instrumental discrimination effects which negate some processes occurring in the ion source. Computations relating elemental physical constants to observed results in a semi-random manner are shown which support this contention. (auth)

5152 DETERMINATION OF HAFNIUM IN THE PRESENCE OF ZIRCONIUM AND TITANIUM. Golovina, A. P.; Tsintsevich, E. P.; Karpovich, A. F.; Kovalenko, E. V.; Zorov, N. B. (Moscow State Univ.). Zh. Anal. Khim.; 28: No. 4, 815-817(Apr 1973). (In Russian).

A possibility was shown of luminescence determination of hafnium with quercetin in the presence of zirconium and titanium using the preliminary separation of these elements by the ascension paper chromatography method. (auth)

5153 USE OF COMPLEXES FORMED BY DIFFERENT LIGANDS (MIXED) IN ANALYTICAL CHEMISTRY. (A Review of Literature Between 1966 and 1970). Pilipenko, A. T.; Tananaiko, M. M. (Kiev State Univ.). Zh. Anal. Khim.; 28: No. 4, 745-778(Apr 1973). (In Russian).

A review of literature devoted to properties of analytically important mixed complexes and their use in analytical chemistry is given. 502 references. (auth)

5154 KINETIC METHODS FOR DETERMINATION OF OSMIUM AND RUTHENIUM. Shlenskaya, V. I.; Khvostova, V. P.; Kalyrova, G. I. (Moscow State Univ.). Zh. Anal. Khim.; 28: No. 4, 779-784(Apr 1973). (In Russian).

Kinetic methods for determination of osmium and ruthenium are examined. 46 references. (auth)

5155 TITRIMETRIC DETERMINATION OF TANTALUM USING ITS ARSENATE. Mamedov, I. A.; Mukhin, O. S. (Inst. of Petroleum and Chemistry, Baku). Zh. Anal. Khim.; 28: No. 3, 521-524(Mar 1973). (In Russian).

Conditions for quantitative separation of tantalum arsenate were studied. A method was developed for determining tantalum in oxalate solutions using its arsenate. (auth)

5156 LUMINESCENCE ANALYSIS AT LOW TEMPERATURE FOR DETERMINATION OF MICROAMOUNTS OF SELENIUM AND TELLURIUM IN SPECIAL PURITY ARSENIC, ANTIMONY, AND THEIR COMPOUNDS. Luft, B. D.; Novikov, V. B.; Khusid, L. B.; Shemet, V. V. (Inst. of Radio-Engineering and Electronics, Moscow). Zh. Anal. Khim.; 28: No. 3, 536-540(Mar 1973). (In Russian).

Luminescence spectra at 77°K were studied for solutions of Te(IV) in hydrochloric acid of different concentration and for solutions of complexes of selenium with 2,3-diaminonaphthalene and 3,3′-diaminobenzidine in toluene and cyclohexane. Methods were developed for the direct fluorimetric determination of Te and Se at 77°K in special purity arsenic trichloride and metallic antimony. The sensitivity of the direct determination of Te in $AsCl_3$ is 5×10^{-6}% and in Sb is 1×10^{-4}%. The sensitivity of determining Te in $AsCl_3$ is as high as 10^{-7}% if the base component is separated by vacuum distillation. The sensitivity of the direct determination of Se in $AsCl_3$ is 5×10^{-7}% and Sb is 1×10^{-6}%. (auth)

5157 KINETIC DETERMINATION OF RUTHENIUM BASED ON OXIDATION OF MERCURY(I) AND DIPHENYLAMINE BY CERIUM(IV). Tikhonova, L. P.; Yatsimirskii, K. B.; Svarkovskaya, I. P.; Zakrevskaya, L. N. (Inst. of Physical Chemistry, Kiev). Zh. Anal. Khim.; 28: No. 3, 561-566(Mar 1973). (In Russian).

Two modifications of a kinetic method for determination of ruthenium based on catalytic reactions of oxidizing mercury(I) and diphenylamine by cerium(IV) sulphate are suggested. The sensitivity is 0.1 μg Ru in 10 ml of the solution, the error is not more than 15%. A method, based on a catalytic reaction of oxidizing diphenylamine with cerium(IV), is suggested for determination of ruthenium in the presence of 10-fold excess of the sum of Au, Pd, Pt, Ir, Rh, and Os. The method permits the determination of down to 1 μg Ru. (auth)

5158 SIMULTANEOUS MICRODETERMINATION OF CARBON, HYDROGEN, TIN, AND A HALOGEN IN HALOGEN-CONTAINING ORGANO-TIN COMPOUNDS. Gel'man, N. E.; Skorobogatova, V. I.; Faershtein, Yu. M.; Korotaeva, I. M. (Inst. of Organic Chemistry, Moscow). Zh. Anal. Khim.; 28: No. 3, 611-614(Mar 1973). (In Russian).

A possibility was proved for simultaneous gravimetric microdetermination of carbon, hydrogen, tin, and a halogen (chlorine, bromine, or iodine) in halogen-containing compounds during the decomposition of a sample in the oxygen atmosphere in a quartz container placed into a tube with a sleeve. Halogen and tin are completely separated under analysis conditions irrespective of whether halogen is bound to an organic radical or to tin. Tin is determined as its dioxide by a gain in the container weight. The standard deviation is 0.27 for carbon, 0.1 for hydrogen, 0.25 for tin and 0.23 for halogen (in abs. percent). (auth)

5159 ANALYSIS OF TANTALUM–NIOBIUM COMPOUNDS BY RADIOMETRIC METHODS. Methods Based on Direct Determination of a Separated Part of Niobium. Shamaev, V. I.; Savkin, M. E. (Chemical-Technological Inst., Moscow). Zh. Anal. Khim.; 28: No. 3, 516-520(Mar 1973). (In Russian).

Three methods for determination of niobium in the presence of tantalum were developed using radiometric correction. The first method is based on precipitation of niobium with cupferron, the second extraction-photometric one includes solvent extraction of niobium as a thiocyanate complex, the third one is based on preliminary separation of tantalum by its extraction into cyclohexanone from 1 N H_2F_2 followed by precipitation of niobium by ammonia from the aqueous phase. (auth)

5160 DETERMINATION OF ZIRCONIUM USING HEXYLDIANTIPYRYLMETHANE. Petrov, B. I.; Zhivopistsev, V. P.; Makhnev, Yu. A. (Perm State Univ., USSR). Zh. Anal. Khim.; 28: No. 3, 505-509(Mar 1973). (In Russian).

The solvent extraction of zirconium from hydrochloric acid solutions by alkyl homologues of diantipyrylmethane was studied. A solution of hexyldiantipyrylmethane in chloroform, dichloroethane, or nitrobenzene is the best extractant. The composition of the complexes extracted was determined. A sensitive chemical-spectral method was developed for determining of Zr in Ti, Th, Sc, La, Ce, Be, and other metals using three-phase extraction systems. (auth)

5161 ESTIMATION OF SENSITIVITY OF ATOMIC-ABSORPTION ANALYSIS OF REFRACTORY METALS. Nikolaev, G. I. Zh. Anal. Khim.; 28: No. 3, 454-463(Mar 1973). (In Russian).

The process of extraction of impurity elements from refractory metals in atomic absorption analysis in a graphite vessel is considered. The results permit the selection of optimal condition for the extraction of an impurity from the metal analyzed and the attainment of limit (from the thermodynamic point of view) sensitivity of the determination. A possibility of determining refractory metals W, Ta, Re, Nb, Hf, Ir, and Zr in a graphite vessel was estimated. The suggested method for selecting optimal conditions for the spectral analysis can be used for different variants of evaporation of solid substances. (auth)

5162 SUBSTOICHIOMETRIC SEPARATION AND DETERMINATION OF CESIUM IN PRESENCE OF POTASSIUM BY ISOTOPE-DILUTION METHOD. Pomerantseva, A. V.; Zimakov, I. E. (Scientific-Research Inst. of Technical Glass, Moscow). Zh. Anal. Khim.; 28: No. 3, 464-467(Mar 1973). (In Russian).

A linear correlation was found between the degree of the attenuation of the counting intensity of stoichiometrically separated samples and the ratio of cesium to potassium in them within a range of 1 : 1 to 1 : 100 (the stoichiometric separation was carried out in the Mg $(DPA)_2$–nitrobenzene system). A substoichiometric method was developed for determining cesium (≥2 mg/ml) in the presence of known amounts of potassium (≤50-fold excess). The method can be also used for determination of cesium in solutions without potassium. The dependence of the degree of the attenuation of the counting intensity on the Cs : K ratio can be used for substoichiometric determination of microamounts of potassium. (auth)

5163 COMPLEX OF SCANDIUM(III) WITH CHROMAZUROL S AND DIANTIPYRYLMETHANE. Alinovskaya, L. A.; Ganago, L. I. (Inst. of Physics of Solids and Semiconductors, Minsk). Zh. Anal. Khim.; 28: No. 4, 661-665(Apr 1973). (In Russian).

Scandium(III) forms a 1 : 2 : 1 complex with chromazurol S in the presence of diantipyrylmethane. Two protons are displaced from two chromazurol S molecules in the complex formation. The instability constant for the complex is 1.17×10^{-12}. Beer's law is obeyed for solutions of the scandium complex. A method for determination of scandium was developed. (auth)

5134 CHEMICAL-SPECTRAL METHOD FOR ANALYSIS OF HIGH PURITY INDIUM. Chalkov, N. Ya.; Ustimov, A. M.; Yudelevich, I. G. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Zh. Anal. Khim.; 28: No. 4, 678-681(Apr 1973). (In Russian).

A chemical-spectral method was developed for determining Ag, Al, As, Au, Bi, Cd, Co, Cr, Cu, Fe, Ga, Mn, Ni, Pb, Sb, Sn, and Te impurities in high purity metallic indium using preliminary concentration by vacuum sublimation of the bulk of indium as indium bromide. The sensitivity of the determination of the impurities is between 2×10^{-7} and 1×10^{-5}%. The coefficient of variation is from 15 to 20%. (auth)

5165 POLAROGRAPHIC DETERMINATION OF SMALL AMOUNTS OF TELLURIUM. Kamenev, A. I.; Vinogradova, E. N.; Russu, A. T. (Moscow State Univ.). Zh. Anal. Khim.; 28: No. 4, 697-703(Apr 1973). (In Russian).

The effect of the accumulation time and potential, supporting electrolyte composition, and element concentration on the height of the tellurium peaks was studied with the use of factorial planning. Optimal conditions were found for determination of tellurium by the method of direct current cathodic polarography with accumulation on a stationary mercury electrode. Small tellurium concentrations of about $n \times 10^{-8}$ g-ion/l can be determined by the method. The coefficient of variation for the height of the tellurium peaks are not more than 10%. Samples of gallium phosphide were analyzed for tellurium, 6.4×10^{-5}% Te (0.1 to 0.3 g samples) were found with a coefficient of variation of 15%. (auth)

5166 KINETIC METHOD FOR DETERMINATION OF 10^{-5} to 10^{-6} PER CENT OF RUTHENIUM IN ORES. Kalinina, V. E.; Boldyreva, O. I. (Ivanovo Chemical-Technological Inst., USSR). Zh. Anal. Khim.; 28: No. 4, 720-723(Apr 1973). (In Russian).

A method is suggested for determining 10^{-5} to 10^{-6}% Ru in ores. The sensitivity is 0.02 μg Ru. (auth)

5167 DEVELOPMENTS IN APPLIED SPECTROSCOPY. Volume 10. Tenth National Meeting of the Society for Applied

Spectroscopy and the Twenty-Second Annual Mid-American Spectroscopy Symposium Held in St. Louis, Missouri, October 18–22, 1971. Perkins, A. J.; Grove, E. L.; Kaelble, E. F.; Westermeyer, J. E. (eds.). New York; Plenum Publishing Corporation (1972). 366p. (CONF-711073-). $26.50.

From 10th national meeting of the Society of Applied Spectroscopy and the 22nd Annual Mid-America Spectroscopy Symposium; St. Louis, Missouri, USA (18 Oct 1971).

Topics considered in the nineteen papers presented are: spectroscopic techniques for the museum, molecular spectroscopy, atmospheric and space spectroscopy, spectroscopy in biomedicine, spectroscopic wear metal analysis in lubricating oils, and x-ray emission spectroscopy. Abstracts were prepared for two of the papers. (DHM)

For abstracts of individual papers see: 5125 and 5126.

5168 DETERMINATION OF TRACE AMOUNTS OF COBALT AND OTHER METALS IN HIGH-PURITY WATER BY USING ION-EXCHANGE MEMBRANES. James, H. (Atomic Energy Establishment, Winfrith, Eng.). Analyst; 98: No. 1165, 274-288(Apr 1973).

Microgram amounts of cobalt, chromium, copper, iron, nickel, and zinc are concentrated on ion-exchange resin impregnated membranes from large volumes of reactor cooling waters. Atomic-absorption measurement on the acid-extracted membranes has permitted the determination of cobalt down to 0.01 $\mu g\ l^{-1}$ in water samples, with an analytical precision of ±12% at the 96% confidence limit, based on twelve replicate observations. Gamma-spectrometric measurement of the nuclide cobalt-60 present in the reactor cooling waters has enabled membrane efficiency to be determined; at cobalt levels of 0.01 and 0.1 $\mu g\ l^{-1}$, the efficiencies are shown to be 85% and greater than 99%, respectively. (auth)

5169 SPECTROPHOTOMETRIC ANALYSIS OF THIN LAYERS OF CADMIUM–SELENIUM AND MERCURY–CADMIUM–TELLURIUM. Marczenko, Z.; Mojski, M.; Czarnecka, I. (Politechnika, Warsaw). Chem. Anal. (Warsaw); 18: No. 1, 189-197 (1973). (In Polish).

Methods of analyzing thin layers of cadmium-selenium and mercury-cadmium-tellurium (of 15 to 150 μg mass) spread over mica or glass were elaborated. Sensitive monochromatic colorimetric methods were used to determine particular elements. Cadmium and mercury were determined with dithizone, selenium with 3,3′-diaminobenzidine, and tellurium with bismuthiol II. The precision of the methods elaborated was established by performing a series of analyses of Cd–Se and Hg–Cd–Te thin layers and by calculating relative values of standard deviations of a single result s_r for particular determinations. An improvement in the overall precision on methods was achieved as a consequence of using a SFR 1 spectrophotometer for measurements of absorption, instead of FEK 56 photocolorimeter. When the SFR 1 spectrophotometer is used for analyses the overall precision depends on the respective precision in the chemical part of the method. The analyses of samples of monocrystals of materials under study have shown that the methods elaborated are characterized by a high accuracy, considering the masses of samples analyzed and the possibilities of the colorimetric method. The analytic method elaborated enables the analysts to check the composition of thin layers. These essentially influence the electrical properties of thin layers. (auth)

5170 SPEKTROFOTOMETRIYA NIOBIYA I TANTALA. (Spectrophotometry of Niobium and Tantalum). Elinson, S. V. Moscow; Atomizdat (1973). 288p.

The subject of color-inducing reactions of Nb and Ta with organic reagents and the complementary topic of the spectrophotometric determination of Nb and Ta in metals and alloys, using specific complex-forming organic compounds are explored in detail. Special attention is given to o,o′-dioxyazo compounds, triarylmethane derivatives, and certain other basic dyestuffs with regard to their use in Nb or Ta determinations. 646 references. (KSW)

5171 APPLICATION OF THIOCYANATE IONS FOR DETERMINATION OF THORIUM. I. Complexometric Determination After Tri-n-butyl Phosphate Extraction. Rozycki, C. (Politechnika, Warsaw). Chem. Anal. (Warsaw); 18: No. 1, 145-150 (1973). (In Polish).

Investigations were carried out on the extraction of thiocyanate complexes of thorium in dependence on concentration of TBP in CCl_4, and of thiocyanate and hydrogen ions in aqueous phase. Conditions of quantitative extraction of thorium were chosen on this basis. Under optimum conditions, the influence of other metals on thorium extraction and its complexometric determination was studied. It was established that nickel, cadmium, cobalt, zinc, aluminium, iron, lanthanum, copper, uranium, bismuth, and magnesium do not hinder the determination of thorium in contrast to gallium, indium, and zirconium. The method elaborated for thorium determination consists in a double extraction from 3.6 M solution of KSCN (pH 1.5—2.5, volume 25 ccm) with 5 ccm of 10% TBP solution in CCl_4. The organic phase is then reextracted with a solution containing 10 ccm of 9 M KSCN and 1 ccm of 0.1 M HNO_3. Then thorium is determined in the organic phase by titration with disodium EDTA after adding 50 ccm of 0.01 M HNO_3 and xylenol orange as indicator. (auth)

5172 SPECTROPHOTOMETRIC DETERMINATION OF NANOGRAM AMOUNTS OF ZINC IN PURE TELLURIUM. Wilczewski, T.; Kozera, F.; Dobrowolski, J. (Politechnika, Danzig). Chem. Anal. (Warsaw); 18: No. 1, 137-144(1973). (In Polish).

A method of separation and determination of zinc in pure tellurium is presented. Zinc was separated by extraction from ammonia solution of Te(IV) at pH 9.7 as a PAN complex. Under such conditions, Te is not extracted. This complex was mineralized by a mixture of $HClO_4$ and H_2SO_4, and Zn was determined from the solution by the dithizone method using toluene as solvent. The volume of the organic phase amounts up to 3 cm^3. The method presented is a specific one. The Zn-Pan complex extracted by chloroform at pH 9.7 has a molar absorptivity coefficient ϵ = 50,000 at λ_{max} = 555 nm. The sensitivity limit γ = 143 $cm^3/\mu g$ Zn. Zinc content in commercial tellurium is equal to $(3.40 \pm 1.0) \cdot 10^{-5}$%, at the probability level of 99% (n = 5). The samples of Te were 250 mg. The presented method proved to be as sensitive in Zn determination as the neutron activation method. (auth)

5173 DETERMINATION OF MOLYBDENUM IN PHOSPHATE STOCKS IN FERTILIZERS. Nabieva, M. M.; Khakimova, V. K. (Inst. of Chemistry, Tashkent). Uzb. Khim. Zh.; No. 1, 13-15 (1973). (In Russian).

The polarographic and photocolorimetric determinations of Mo in fertilizers was demonstrated. The photocolorimetric method was based on the coloration produced by phosphotungstomolybdic blue at a pH of 1 to 1.5, and was deemed convenient for the analysis of Mo in superphosphate mixtures. The polarographic method was useful for ascertaining the Mo content of phosphate stocks (6.2×10^{-4} to 1.34×10^{-3}%), or in fertilizers (1.7×10^{-5} to 6.8×10^{-4}%) in the presence of HCl. Both methods are sufficiently accurate and reproducible. (tr-auth)

5174 ARSENATE–IODIMETRIC DETERMINATION OF LANTHANUM. Mamedov, I. A.; Guseinova, Z. H. Uch. Zap., Azerb. Inst. Nefti Khim., Ser. 9; No. 2, 83-86(1971). (In Russian).

Optimum conditions for the precipitation of La as La AsO_4 and subsequent iodimetric titration of the AsO_4^{3-} were established. To 20 ml of hot test solution (0.72 to 140 mg of La) add aqueous NH_3 (1:5) dropwise, with stirring, to give a slight turbidity, add sufficient HCl (1:1) to remove this and 0.3 to 0.5 ml in excess, heat the solution to boiling point and add 20 ml of hot 20% Na_3AsO_4 solution (acidified to methyl orange with HCl). Keep the mixture just below boiling point for 5 to 6 min, then filter off the precipitate, wash it (×8 to 10) with 2% NH_4Cl solution, and dissolve it in 25 to 30 ml of HCl (1:1). To the solution obtained add 20 to 25 ml of benzene, 3 ml of fresh 3N–KI, and an equal volume of water, and titrate with 0.1N–$Na_2S_2O_3$ until the organic layer is colorless. A 40-fold excess of alkali metal, Ca, Mg, Co, Ni, or Cd does not interfere. (Ref. Zh.)

5175 DETERMINATION OF C, O, AND N IN ZIRCONIUM AND ITS ALLOYS. Kraft, G. (Metallgesellschaft AG, Frankfurt am Main); Kahles, A. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1972). 6p. (In German).

From meeting: gases in metals; Darmstadt, Ger. (2 Mar 1972).

The determination of C, N, and O in zirconium and its alloys presents particular difficulties as far as reproducibility is concerned. The importance of admixtures and of the composition of the combustion gas in the course of the analytical determination of carbon by combustion is reported. Using an iron admixture, reproducible results are obtained when sample and admixture are sintered first with the sintered material then being burned with oxygen. Nitrogen and oxygen are determined by the hot extraction method, using a palladium admixture to lower the melting point. By using a high palladium: sample ratio, which prevents the melt from getting tenacious by carbide precipitation, a good reproducibility of the analytic results can be reached. (GE)

5176 HANDBUCH DER ANALYTISCHEN CHEMIE. Dritter Teil. Quantitative Bestimmungs- und Trennungsmethoden. Elemente der Sechsten Nebengruppe. Band VIbβ. Uran. (Handbook of Analytical Chemistry. Part 3. Quantitative determination and separation methods. Elements of the sixth subgroup. Volume VIbβ. Uranium). Fresenius, W. (ed.). Berlin; Springer Verlag (1972). 535p. $53.30.

Methods for the separation and quantitative determination of uranium are described. The content is subdivided into gravimetric methods, titrimetric methods, and photometric methods. Also discussed are polarographic, coulometric, and electrolytic methods as well as chromatography, extraction, spectral analysis, and radiochemical methods. The final chapter treats the analysis of irradiated nuclear fuel elements. (HBG)

5177 RING ANALYSIS FOR THE DETERMINATION OF NITROGEN IN TANTALUM. Kraft, G. (Metallgesellschaft AG, Frankfurt am Main); Paesold, G.; Tombue, C. G.; Lassner, E. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1972). 5p. (In German).

From meeting: gases in metals; Darmstadt, Ger. (2 Mar 1972).

On the basis of a comparison of results obtained with powdered as well as with compact samples of tantalum, the authors demonstrate the effectiveness of the following analytical methods for the determination of nitrogen in tantalum: hot extraction in a vacuum as well as in a carrier gas stream; the Kjeldahl-method; and sodium hydroxide melting. A concentration range between 5 to 500 ppM N_2 was studied. (GE)

5178 CRITICAL EXAMINATION OF METHODS OF EXTRACTION OF TRACES OF RARE-EARTH ELEMENTS FROM RAW MATERIALS WITH AN ALUMINUM BASE. Serrini, G. Alluminio; 40: No. 10, 493-497(1971). (In Italian).

Two extraction methods based on selective volatilization are discussed. For the small traces sought a complete dissolution of the Al-base powders followed by precipitation of the rare-earth oxides and an organic solvent extraction was the only satisfactory method. This enabled the estimation of traces down to 0.1 ppM of La, Eu, and Gd by either an emission spectrochemical or x-ray fluorescent method to be carried out. The yield was verified by the use of synthetic alloys to which ^{152}Eu had been added as a tracer. (Metals Abstracts)

5179 GAMMA-SPECTROSCOPIC FAST DETERMINATION OF THORIUM IN TUNGSTEN-WELDING-ELECTRODES. Ortner, H. M. (Metallwerk Plansee AG, Reutte/Tyrol, Austria). (1972). vp. (In German).

From 1st European conference on analytical chemistry; Heidelberg, Germany (28 Aug 1972).

The ThO_2-contents in thorated W-electrodes was determined quantitatively by γ-spectroscopy of the daughter nuclides ^{228}Ac, ^{212}Pb, ^{208}Tl, and ^{212}Bi (highest γ-intensity at γ-energies of 90 to 500 keV, range 90 to 2,000 keV) after sintering of the electrodes at 2,300°C. For the elaboration of the measuring method, the difficulty of establishing a relationship between the γ-activity and the ThO_2-contents was to find W-electrodes of different diameters but of known uniform ThO_2-initial charge. The pulse rate measured for a certain electrode depends upon the ThO_2-concentration c and the diameter d of the electrodes, $\log I/c = \log k + n \times \log d$, n found to be 1.67; (the γ radiation generated in the interior of the electrodes is partially absorbed again by the dense W-matrix). The pulse rates found for various diameters are normalized to the rate according to a diameter of 1 mm not to need a separate calibration curve for each electrode diameter. Furthermore the radial distribution of ThO_2 of the W-electrodes was determined simply by turning them off and measuring the specific activity of the gathered and crushed chips. (GE)

5180 DETERMINATION OF TRACE AMOUNTS OF LANTHANUM WITH ARSENAZO III. Kondratova, T. S. Tr. Voronezh. Tekhnol. Inst.; No. 18, 76(1970). (In Russian).

To the test solution (2 to 12 μg of La) add 5 ml of 1% ascorbic acid solution (to reduce Fe III present), adjust the pH to 2.0, add 5 ml of 20% urea solution (to remove the effect of HNO_3 present in the solution), and add 5 ml of buffer solution of pH 1.8 to 2.0. After 2 to 3 min. add 2 ml of 0.1% arsenazo III solution, dilute to 25 ml with 0.01N-HCl, and measure the extinction (red filter) against a blank. The sensitivity is 0.04 μg of La per ml, and the reproducibility is ±10%. Up to a 1000-fold amount of Fe III (relative to the La) is tolerated. (Ref. Zh.)

5181 ARSENATE-IODIMETRIC DETERMINATION OF CERIUM(IV), THORIUM, AND ALUMINUM PRESENT TOGETHER. Mamedov, I. A.; Nabiev, M. N. Uch. Zap., Azerb. Inst. Nefti Khim., Ser. 9; No. 3, 100-103(1971). (In Russian).

The test solution is divided into three portions. From the first, the three metals are precipitated as arsenates, and their sum is determined by iodimetric titration of a solution of the precipitate in H_2SO_4. In the second portion, the Ce is determined by direct iodimetric titration, and the third portion is used to determine the sum of Ce and Th as described previously. (Ref. Zh.)

5182 INFLUENCE OF THE CONCENTRATION OF ELEMENTS OF DIFFERENT VOLATILITIES IN SPECTROCHEMICAL ANALYSIS. III. Alvarez Herrero, C.; Burriel-Marti, F.; Palacios Corvillo, M. A. (Univ., Madrid). Inform. Quim. Anal., Pura Apl. Ind.; 26: No. 3, 126-134; 144(1972). (In Spanish).

The effect of one element on the spectrographic determination of the other has been studied for the following pairs containing either element as major constituent—Cr–La, Mo–Y, W–Zr, Na–Be, Tl–Si, Ba–Li, Sc–Ga, Co–In, Ta–Cs, Nb–Rb, Ti–K, and W–Hg. In general, one element of the pair affected the spectral lines of the other. For example, in the group W–Zr, Co–In, Ta–Cs, Nb–Rb, Ti–K, and W–Hg, each element always reduced the intensity of the lines of the other; in the group Cr–La, Mo–Y, Tl–Si, and Sc–Ga, the more-volatile element reduced the intensity of the lines of the other element, but the less-volatile element increased the intensity of the lines of the more-volatile one. (Anal. Abstr.)

5183 SEPARATION OF TRACES OF RARE EARTH METALS FROM ALUMINUM-BASE MATERIALS: CRITICAL EXAMINATION OF SOME METHODS. Serrini, G. (CCR–EURATOM, Ispra, Italy). Allum. Nuova Met.; 40: No. 10, 493-497(1970). (In Italian).

Serious losses can occur during the separation of rare earth metals (La, Gd and Eu at ≈1 ppM levels) from Al by volatilization of the Al with HCl or S_2Cl_2, but separation by coprecipitation with Fe^{3+} gives at least 95% recovery. Dissolve 1 to 10 g of the sample in 50% HCl, and filter. Calcine the residue at low temperature, fuse it in a platinum dish with $KHSO_4$, dissolve the melt in H_2O and combine with the HCl solution. Add 5 to 10 mg of Fe^{3+}, a few drops of aqueous H_2O_2 or HNO_3 and then sufficient 20% NaOH solution to the hot solution to redissolve the $Al(OH)_3$. Set aside for 15 min., filter, and wash with 2% NaOH solution. Dissolve the precipitate in HCl (1 : 2) and re-precipitate the $Fe(OH)_3$ as above. Dissolve the precipitate in HCL (1 : 2), add NH_4Cl and neutralize with aqueous NH_3, filter and wash with 1% NH_4Cl solution plus a few drops of aqueous NH_3 and finally with H_2O. Dissolve the precipitate in 6N-HCl (20 ml) and extract with isobutyl methyl ketone (2 × 5 ml) to remove Fe^{3+}. Wash the organic phase with 6N-HCl (5 ml), combine the HCl solution, evaporate to dryness, add 1 to 2 ml to HNO_3 and evaporate most of the HNO_3. Dilute to 5 ml with 6N-HCl for spectrographic determination (use Pd as internal standard) or with 0 · 1N-HNO_3 for x-ray fluorescence determination (use Sc as internal standard). (Anal. Abstr.)

5184 APOLLO 14 RARE GASES; ^{244}Pu XENON. Ragan, D. P. St. Louis; Washington Univ. (1972). 240p. University Microfilms Order No. 73-5057.

Thesis (Ph. D.).

The first results of rare gas measurements on the recently constructed mass spectrometer facility are reported. Four stepwise temperature extractions were made on Apollo 14 samples 14306-light, 14306-dark, 14301, and 14311. Neon, argon, krypton, and xenon data are reported. ^{81}Kr–Kr ages were found to be: 14306 – 24.6 ± 1.6 my., 14301 – 102 ± 30 my., and 14311 – 505 ± 60 my. Analysis of xenon in 14301 shows a large enrichment of the heavy isotopes due to the decay of now extinct ^{244}Pu. The separation of the fission gas from the spallation gas in the different temperature fractions allowed a measurement of the fission xenon yield spectrum: $^{129}Xe/^{131}Xe/^{132}Xe/^{134}Xe/^{136}Xe = 27.1 \pm 3.1/30.5 \pm 1.3/87.6 \pm 1.9/91.4 \pm .9/100$. This is very close to the measured yield spectrum of artificially produced ^{244}Pu. Computations on the spallation spectrum in the rocks were made. Evidence for more than one component in a rock was observed in 14301 and 14311. The spectrometer used to measure the gases is described in detail. Two features original with this spectrometer are the automatic data acquisition system and the peak jumping (switching) hardware. These two technical improvements are also discussed in full. (Diss. Abstr. Int., B)

5185 URANIUM(VI) COMPLEXES WITH MORDANT BLACK DYES. Spectrophotometric and Potentiometric Studies. Mushran, S. P.; Prakash, O.; Murti, R. (Univ. of Allahabad, India). J. Inorg. Nucl. Chem.; 35: No. 6, 2119-2123(Jun 1973).

The complexes of uranium(IV) with Eriochrome black T [1-(1-hydroxy-2-naphthylazo)-6-nitro-2-naphthol-4-sulphonate, abbreviated EBT], Solochrome black 6BN [1-(1-hydroxy-2-naphthylazo)-2-naphthol-4-sulphonate, abbreviated, SBN], and calmagite [1-(1-hydroxy-4-methyl-2-phenylazo)-2-naphthol-4-sulphonic acid, abbreviated, CLG], were studied photometrically and potentiometrically. The nature and composition of the complexes, and their analytical applications are discussed. The proton dissociation constants of EBT, SBN, and CLG and the stepwise formation constants of the complexes were evaluated potentiometrically. (UK)

Radiometric and Radiochemical Procedures

Refer also to abstracts 5425, 5545, 5618, 5654, 5759–5761, 5763–5765, 5767, 5769, 5774, 5779, 6218, 6219, and 6448.

5186 (ANL-7972, pp 34-41) IN-LINE ANALYSIS IN FUEL FABRICATION. Schnizlein, J. G.; Gerding, T.; Steindler, M. J. Dec 1972.

Study of the potential of x-ray fluorescence (XRF) as an in-line analytical method for determining the plutonium content of fast breeder reactor (FBR) oxide fuels was completed for green and sintered pellets of the Fast Flux Test Facility (FFTF) type having Pu/(U + Pu) ratios of 0.20, 0.25, and 0.30. The precision of analysis of plutonium content, Pu/(U + Pu), by measurement of the XRF signal fraction was determined for these three compositions by analysis of variance and regression analysis. The analysis of variance showed the relative standard deviation (RSD) of measurements of signal fraction to be between 0.14 and 0.23% with the 95% confidence limits between 0.11 and 0.40%. For pellets other than those with 20.2 wt % Pu, results of the F test showed the variance between pellets to be not significantly greater than the variance of measurements. Therefore, it is concluded that the mill-mixing and blending operation produces adequate uniformity of composition within a batch. (DHM)

5187 (BDX-613-859(Rev.)) SOLUBILITY PARAMETER TECHNOLOGY AND EVAPORATIVE RATE ANALYSIS USED TO EVALUATE CONTAMINANTS. Jackson, L. C. (Bendix Corp., Kansas City, Mo.). May 1973. Contract AT(29-1)-613. 7p. Dep. NTIS $3.00.

Solubility parameter technology is used to evaluate the general nature of contaminants detected by evaporative rate analysis. Descriptions of the evaporative rate technique and solubility parameter principle are given. The combination of these two technologies was shown to indicate potential in distinguishing differences between contaminants. (auth)

5188 CEA-R-4422) GAMMA SPECTROMETRY WITH Ge(Li) SEMICONDUCTORS IN DRILLING OPERATIONS. Application to Estimations of the Quantity of U Contained in Rocks. Andrieux, C. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1973. 75p. (In French). Dep. NTIS (U. S. Sales Only) $5.75.

Thesis.

The progress made in γ spectrometry using Ge(Li) detectors led to the construction of a geological probe equipped with this type of detector intended for the development of new measurement techniques. This probe, which has a diameter of 57 mm, encloses a liquid nitrogen cryostat containing the detector and can operate without attention for 15 hours. The main component of the electronics at the surface is an amplitude analyser. The results are recorded on punched tape, thus facilitating the computerized handling of the data. The method suggested consists of measuring the intensity of the 185 keV/^{235}U gamma line using N different spectra recorded at N points on the radioactive layer. The interpretation of the data obtained led to the direct determination of the U contents of ores from measurements of the ^{235}U isotope activity. In this way the disequilibrizing U/Ra effect can be overcome. The results obtained from drillings in the Lodève permian bassin (Hérault, France) compare favorably with chemical measurements made on core samples. (auth)

5189 (CISE-N-158) METHOD FOR THE DETERMINATION OF THE PRINCIPAL FISSION PRODUCTS CONTAINED IN FALL-OUT SAMPLES. Albini, A.; Bonfanti, G.; Cattaneo, C.; Giacoletto, C.; Triulzi, C. (Centro Informazioni Studi Esperienze, Milan (Italy)). Dec 1972. 37p. (In Italian). Dep. NTIS (U. S. Sales Only) $4.00.

Since 1961 radioactivity measurements on fallout samples have been performed at CISE (Centro Informazioni Studi Esperienze): samples are collected within the area of the Centre located at Segrate (about three miles east of Milan); collections are made monthly and sometimes, after nuclear atmospheric tests, weekly. The present technical report describes methods for sample collection and preliminary treatments: the obtained concentrates are previously measured for gross beta activity content, analyzed by gamma spectrometry, and then submitted to radiochemical separation. Chemical separation methods and radiometric techniques set up to determine ^{90}Sr, ^{137}Cs, ^{144}Ce, ^{147}Pm, ^{155}Eu, ^{95}Zr, as well as ^{131}I, ^{103}Ru, and ^{106}Ru are reported in detail step by step. (auth)

5190 (GEPP-105) NONDESTRUCTIVE DETERMINATION OF AREAL DENSITY AND TRITIUM CONTENT OF TRITIDED ERBIUM FILMS USING BETA EXCITED X RAYS. Pearson, J. E. (General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.). 25 May 1973. Contract AT(29-2)-656. 22p. Dep. NTIS $3.25.

The x-ray spectrum emitted from a tritided erbium film as a result of the beta decay is used to determine areal density and tritium content of the film. A Si(Li) detector and a dedicated mini-computer are used for detection, acquisition and data reduction. The technique is suitable for areal densities of erbium from 0.01 mg/cm^2 to as high as 10 mg/cm^2. The occluded tritium can be measured from less than one to several hundred micron-liters. Precision is determined by counting errors and is typically less than 1% for a five-minute count while accuracy depends upon the empirical calibration technique. (auth)

5191 (KFK-1728) DETERMINATION OF TUNGSTEN IN ORES BY NONDISPERSIVE X-RAY FLUORESCENCE ANALYSIS. Lubecki, A.; Vogg, H. (Kernforschungszentrum, Karlsruhe (West Germany). Laboratorium fuer Isotopentechnik). Jan 1973. 59p. (In German). Dep. NTIS (U. S. Sales Only) $5.00.

The determination of W in ore samples by nondispersive x-ray fluorescence analysis was studied. A good agreement between theoretical calculations and experimental results is shown. The method is practically independent from matrix, if the ratio fluorescence radiation/Compton scattered radiation is used. The combined method is influenced by geometry conditions. For the analysis of natural ore samples a good agreement between reactor activation analysis and x-ray fluorescence analysis has been found, especially, if average calibration curves for simple fluorescence method or the combined method fluorescence radiation/Compton scattered radiation are applied. A simple estimation of optimal geometry conditions for borehole measurements is given. As primary radiation ^{57}Co is more convenient than ^{109}Cd. Using ^{57}Co the application of a NaI-detector and according to this a simple and cheap measuring system is possible. (GE)

5192 DETERMINATION OF THE MINUTE AMOUNT OF NITROGEN IN PURE IRON BY ISOTOPIC DILUTION METHOD. Kikuchi, T. (Tokyo Univ.). Bunseki Kiki; 10: No. 10, 685-695(Oct 1972). (In Japanese).

The isotopic dilution method adopted so far for the determination of gases in metal is reviewed. Determination of nitrogen in the zone-melted pure iron was attempted by the isotopic dilution method using Al ^{15}N as the tracer. Descriptions were given on the method of the aluminum nitride synthesis and the apparatus used for the determination, and the condition for attaining the isotopic equilibrium between ^{15}N and ^{14}N in the molten iron was studied. The result was compared with those obtained by the Kjeldahl method and the solid mass spectrograph method. (Japan)

5193 RADIOCHEMICAL ANALYSIS OF SURFACE WATER. Aleksan'yan, O. M. Gidrokhim. Mater.; 53: 163-167(1972). (In Russian).

The method described for determining ^{90}Sr and ^{137}Cs in seawater or river water involves isolation of the radionuclides, in the presence of Sr and Cs carriers, by precipitation as the carbonate and ferrocyanide, respectively. The carbonate is dissolved in 0.5N to N–HCl and the Sr in this solution is precipitated as oxalate, the precipitate is ignited, and a solution of the product in 2N–HCl is set aside for accumulation of ^{90}Y; this is precipitated as hydroxide (and again as oxalate) for β-counting. The ferrocyanide precipitate, containing ^{137}Cs, is ignited at <400°, the residue is extracted with boiling H_2O, the extract is evaporated, and a solution of the residue in acetic acid is so treated as to precipitate Cs as $Cs_3Bi_2I_9$ for β-counting. (Anal. Abstr.)

5194 MEASUREMENT BY 59.6 keV AND 140 keV GAMMA RADIATION OF THE MINERAL CONTENT IN BONE. Spring, E.; Hoikkala, M. (Univ. of Helsinki). pp 113-115 of Second Nordic Meeting on Medical and Biological Engineering. Oslo; Norsk Forening for Bio-Medisinsk Teknikk (1972).

From proceedings of the second Nordic meeting on medical and biological engineering ; Oslo, Norway (16 Jun 1971).

The mineral content of bone has been measured using the 59.6 KeV gamma radiation from ^{241}Am. To make unnecessary the placing of the object of measurement in water to ensure a uniformly thick absorption medium of soft tissue and water, a ^{99m}Tc source, emitting 140 KeV gamma radiation, was also used. The results were reproducible within 2%, a slight improvement on previous results not using ^{99m}Tc. (NO)

5195 NOVEL ASPECTS OF THE CONTROL OF ENVIRONMENTAL RADIOACTIVITY, WITH SPECIAL REFERENCE TO METHODS OF MEASUREMENT OF INTEGRAL β- AND γ-ACTIVITIES. Polgar, E. (Orszagos Kozegeszsegugyi Intezet, Budapest). Izotoptechnika; 16: No. 3, 113-122(Mar 1973). (In Hungarian).

Measurement of integral β-activity of soil samples, collected in the environment of the Central Research Institute for Physics of the Hungarian Academy of Sciences, is reported as well as radium contamination from coal-fired power stations and the activity of their ashes. (auth)

5196 DETERMINATION OF THE COMPOSITION OF TIN-LEAD COATINGS AND ALLOYS USING BACKSCATTERED β-

RADIATION. Tumul'kan, A. D. Ind. Lab. (USSR) (Engl. Transl.); 38: No. 6, 919-920(Jun 1972).

Translated from Zavod. Lab.; 38: No. 6, 717-718(Jun 1972).

For rapid determination of the content of tin in alloys of tin–lead solder and thin galvanized tin–lead coatings (15 to 30 μ) on brass radiator pipes, a method using the back scattering of β radiation was developed. The equipment consists of a gas-discharge transducer BDGS-1, a feed unit, and a conversion apparatus. Technical characteristics of the experimental apparatus are given. The accuracy with which tin is determined by this method, although lower than the accuracy of chemical analysis, nevertheless satisfies production requirements. The advantage of the method proposed is that it is simple and cheap to use and enables fast, nondestructive testing. With a source of ^{90}Sr + ^{90}Y of the type BIS-M in the transducer, the experimental apparatus makes it possible to measure the thickness of tin–lead coatings on brass pipes under laboratory conditions with an accuracy of ±1 μ in 40 sec in a range of 5-35 μ. (auth)

5197 DETERMINATION OF TRITIUM ACTIVITY IN MILK FAT BY LIQUID SCINTILLATION COUNTING USING THE EXTERNAL STANDARD CHANNELS-RATIO METHOD. van den Hoek, J.; Oudenaarden, C. P. J. Ned. Melk-Zuiveltijdschr.; 25: No. 4, 269-273(1971).

The method overcomes the variation in counting efficiency caused by the variable coloration of milk-fat samples. To a range of colored samples was added a scintillation mixture [0.4% of 2,5-diphenyloxazole and 0.01% of 1,4-bis-(5-phenyloxazol-2-yl)benzene in toluene]. The samples were counted, and then counted again after the addition of 10 μl of standard [1,2-^{3}H]hexadecane. The scintillation counter was equipped with a ^{133}Ba external-standard source. The relationship between counting efficiency and channels ratio for the external standard was rectilinear. This method proved reliable and convenient and could probably be used for ^{14}C-labelled milk fat. (Anal. Abstr.)

5198 SEMICONDUCTOR SPECTROMETER FOR IN VIVO LEAD-210 MEASUREMENTS. Eckerman, K. F. Evanston, IL; Northwestern Univ. (1972). 259p. University Microfilms Order No. 73-10,214.

Thesis (Ph. D.).

The body burden of ^{210}Pb has been suggested as an index of the integrated exposure to radon and its short-lived daughter products. The burden of ^{210}Pb can be determined by measurement of the 46.5 keV γ ray which is so highly converted that it appears in only 4% of the disintegrations. The conventional detectors for in vivo measurements, namely solid state scintillators, are limited in sensitivity in this energy region. The development of semiconductor detectors with their characteristics at low noise, low Z, and outstanding resolution suggest their use for the measurement of deposited ^{210}Pb. To define the potential of these detectors in this application, an analytical and experimental investigation of spectrometer response was undertaken. The spectrometer response function Q, the square of the signal divided by the background was evaluated, using Monte Carlo methods as a function of detection area and thickness for silicon and germanium detectors. The NaI and CsI scintillation detectors were also evaluated for comparison. The silicon detectors were limited in response due to low ^{210}Pb detection efficiency. The germanium detectors, although limited by the spectrometer electronics, were indicated to be an attractive alternative to the scintillation detectors. Experimental measurements on various semiconductor detectors confirmed that germanium was the semiconductor medium of choice. In vitro ^{210}Pb measurements on a number of victims of radium poisoning demonstrated the capability of a germanium detector. The high information content of the low energy region of the in vitro spectra makes possible an assessment of the ^{210}Pb/^{226}Ra ratio without direct evaluation of the corresponding activities. For high burden-long term radium cases a study of the distribution of the ^{210}Pb/^{226}Ra ratio within the various bones of the skeleton could be conducted with relative ease. In addition, the potential exists for in vivo determination of the ratio to provide a direct measurement of the radon retention parameter. (Diss. Abstr. Int., B)

5199 RADIOMETRIC METHOD FOR DETERMINING SMALL AMOUNTS OF ZINC IN CADMIUM COMPOUNDS. Shamaev, V. I.; Martynov, A. M. (Chemical-Technological Inst., Moscow). Zh. Anal. Khim.; 28: No. 3, 479-483(Mar 1973). (In Russian).

Substoichiometric separation of zinc and cadmium by a dithizone solution in chloroform was studied as a function of pH and NaI concentration. A radiometric method was developed for determining zinc in cadmium compounds. The accuracy and sensitivity of the determination of zinc by the method of radiometric correction were investigated. (auth)

5200 MEASUREMENT OF ^{32}P IN WET-ASHED PLANT SAMPLES UTILIZING CHERENKOV RADIATION. Haasbroek, F. J.; De Villiers, J. F.; Deist, J.; Rosseau, P. C. (Food and Fruit Tech. Research Inst., Stellenbosch, S. Afr.). Agrochemophysica; 3: No. 2, 27-31(1971).

The radiometric assay of ^{32}P in plant material by means of Cherenkov counting was investigated. Plant material was ashed with nitric and perchloric acids and any color remaining in the solutions could easily be removed with activated charcoal. Measurements were done in an automatic liquid scintillation counter using either a wide-window discriminator setting including the whole ^{32}P Cherenkov spectrum or a 5% window combined with balance-point operation. The efficiency of the later method was 25% compared to 41% with the wide-window. However, balance-point operation is preferred because it was less affected by quenching agents and up to 3g samples could be counted without change in efficiency. By using a quenched ^{90}Sr–^{90}Y reference source any deviations in instrumental settings could easily be detected. (INIS)

5201 INEXPENSIVE ISOTOPIC FACILITY FOR THE DETERMINATION OF DEUTERIUM. Van der Westhuizen, M. Int. J. Appl. Radiat. Isotop.; 24: No. 4, 193-196(Apr 1973).

Deuterium is a useful tracer where the behavior of water is investigated in small scale experiments. Deuterium determination by mass spectrometry requires expensive equipment and therefore a cheap and practical facility was constructed to determine deuterium by the (γ,n) method. The availability of a reactor made ^{24}Na a practical source of gamma rays. The source was transported and stored in a special lead holder and compressed air was used to bring the source to the sample and to return it. With paraffin wax as moderator, the deuterium in natural water (0.015%) was counted with a rate of 195 cpm above a background of 705 cpm. The coefficient of variation was 6.2%. With graphite as moderator, water gave a count rate of 123 cpm above a background of 49 cpm, rendering a coefficient of variation of 3.8%. The calibration curve is always a well defined straight line, going through the origin. (auth)

5202 ANALYTICAL METHOD AND APPARATUS. Benson, R. H. (To Monsanto Co.). British Patent 1,304,694. 24 Jan 1973. Filed date 8 Jan 1970. 10p.

A method is described for determining labile hydrogen-containing compounds, comprising the following steps: (a) passing the sample through a fixed phase of fibrous labile tritium-containing substrate, whereby the labile hydrogen in the compound exchanges with the labile tritium in the substrate; (b) measuring the radioactivity of the T-containing effluent; (c) calculating the quantity of labile hydrogen containing compound. The method constitutes a procedure whereby labile hydrogen containing compounds or compounds or elements that are convertible to such compounds can be determined with good accuracy even when present in very low concentrations in mixtures. The fibrous labile T-containing substrate may be selected from solid aromatic hydroxy-compounds, inorganic hydroxides, polymeric aromatic amines or amides, polysulphonamides, or polybenzothiazoles. A fluid carrier stream is employed to transport the sample through the substrate column. (UK)

5203 EXCITATION OF CHARACTERISTIC TUNGSTEN RADIATION BY ^{109}Cd AND ITS UTILIZATION FOR DETERMINATION OF TUNGSTEN IN IRON. Havranek, E.; Bumbalova, A.; Herchl, M. (Laboratorium Nuklearnej Farmacie FaFUK, Bratislava). Chem. Listy; 67: No. 3, 290-295(Mar 1973). (In Czech).

A method was elaborated for the determination of tungsten in steel by means of radionuclide x-ray fluorescence analysis using ^{109}Cd for the excitation of the K-fluorescence radiation of tungsten. The separation of the fluorescent tungsten radiation was carried out in two ways—by amplitude selection and selection using a pair of differential Ross filters. In both cases a detection limit better than 0.1% was achieved. (auth)

5204 EXPERIMENTAL TECHNIQUE OF RADIO GAS CHROMATOGRAPHY. Kasida, Y. Kagaku No Ryoiki, Zokan; No. 95, 149-169(1971). (In Japanese).

A review of radiogaschromatography is presented that details the determination of the radioactivity of material after combustion in a furnace. (DHM)

5205 MICRODETERMINATION OF [^{14}C] LACTATE IN BIOLOGICAL FLUIDS. Kusaka, M.; Ui, M. (Hokkaido Univ., Sapporo). Anal. Biochem.; 52: No. 2, 369-376(Apr 1973).

A simple method, based on a single-step conversion of lactate to pyruvic acid semicarbazone by lactic dehydrogenase, was developed for the microdetermination of [^{14}C] lactate in the biological fluids. Pyruvic semicarbazone thus formed is efficiently separated from other labelled metabolites by means of charcoal treatment followed by thin-layer chromatography on cellulose plate. The entire procedure applied to rat whole blood revealed the mean recovery of 75.2% with a good reproducibility. (auth)

5206 PROCESS FOR DETERMINING THE FISSILE SUBSTANCES IN FUEL OR FERTILE ELEMENTS. Dieck, E. L. (to Kernforschungsanlage Juelich GmbH). German Patent 1,940,914. 25 Feb 1971. Filed date 12 Aug 1969. (In German).

The process is characterized by the fact that the elements or samples for measurement as well as a quantity corresponding to the number of fissile materials for determination of one or more of the materials for comparison containing fissile materials for determination are exposed respectively to neutron irradiations corresponding in regard to the number of fissile materials to be determined with a different neutron speed. The content of fissile material is then determined by a known method starting with the various values determined for the decrease in activity. (EJH)

5207 ELECTRON MICROPROBE ANALYSIS OF THE Ta–O SYSTEM. Ingrey, S. J.; Westwood, W. D. (Bell-Northern Research and Development Labs., Ottawa). J. Phys., D (London); 6: No. 7, 896-908(1 May 1973).

The detection system of an electron microprobe was modified to increase its sensitivity to soft x-rays, absorbed oxygen in a tantalum single crystal being readily detected. The oxygen concentration within about 400 Å of the surface was determined for a number of samples by comparison with a set of standards. The standards were sputtered tantalum films with oxygen concentrations between 8.3 and 71.4 at.%, as determined from anodization efficiencies. For the single crystal the oxygen concentration was approximately 3 at. %, but ion-scattering spectrometry showed that the oxygen concentration decreases with increasing distance from the surface. The energy of the OK_α radiation was 6.0 ± 1.4 eV higher than for Ta_2O_5, and the oxygen may be present interstitially in the tantalum crystal. Similar results were obtained for a sputtered tantalum film with the BCC structure. For a sputtered β-Ta film the oxygen concentration was approximately 10 at. % and did not decrease with increasing depth. The oxygen is probably incorporated during deposition and the OK_α energy was the same as for Ta_2O_5. Tantalum foil annealed in oxygen at temperatures up to 600°C increased in oxygen content according to an activation energy of 0.47 ± 0.08 eV. At 350°C, the surface concentration was 30 at. %, but no second phase was observed. Segregation of a second phase, with an oxygen concentration of 58 at. %, was observed at 400°C, and Ta_2O_5 was formed at higher temperatures. (auth)

5208 APPLICATIONS OF NON-DISPERSIVE X-RAY FLUORESCENCE TECHNIQUES FOR IN VITRO STUDIES. Baglan, R. J.; Brill, A. B.; Patton, J. A. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 379-388(Feb 1973).

The x-ray fluorescence technique is discussed with respect to those parameters which promise to increase its sensitivity including excitation sources, sample preparation, and detectors. Applications in medicine are discussed including analysis of biological fluids, tissues, and kidney stones. (DHM)

5209 MICRODETERMINATION OF SERUM COPPER BY MEANS OF RADIOISOTOPIC DILUTION. Vrignaud, M. C.; Vrignaud, N.; Blanquet, M. P. (Lab. Physique Pharm., Bordeaux). Bull. Soc. Pharm. Bordeaux; 110: No. 2, 83-90(1971). (In French).

Place the serum (2 ml), obtained from blood that is collected always at the same hour of day, and 0.2M-HCl (1 ml) in a centrifuge tube tube and set aside for 1 hr at room temperature. Add 20% trichloroacetic acid solution (3 ml) and centrifuge for 10 min. Prepare a range of test tubes as follows: to two of the tubes add standard aqueous $CuCl_2$ (1 μg of Cu per ml) (2 ml in each tube), and to three more add supernatant liquid (2 ml, 1 ml, 0.5 ml). In each tube and in two empty tubes place 2 ml of $CuCl_2$ solution labeled with ^{64}Cu (0.5 μg per ml), a few drops of cresol red and concentrated aqueous NH_3 until the solution is yellow. Add phosphate-citrate buffer solution of pH 2.3 (4 ml), H_2O to make 10 ml, and a freshly prepared solution of dithizone (1 ppM) in CCl_4 (1.4 ml) to each tube. Shake the solution for 0.5 hr and measure the activities of 0.5-ml portions of the organic layers. A comparison with colorimetric and atomic-absorption methods shows the proposed method to be more sensitive; it can be applied to as little as 0.02 μg of Cu. (Anal. Abstr.)

5210 RADIOCHEMICAL METHOD OF DETERMINING LOW LEVELS OF STRONTIUM-90 CONCENTRATION IN SAMPLES OF THE AMBIENT. Chumichev, V. B. Tr. Inst. Eksp. Meteorol.; No. 25, 161-165(1972). (In Russian).

A detailed description of a radiochemical procedure for determining ^{90}Sr from 10 liters of seawater by using a low-background radiometric unit (background 4 to 6 pulses per hr) designed for measuring the β-emission of the daughter ^{90}Y is given. The procedure appreciably facilitated the collection and preliminary processing of seawater samples, cut down on the expenditure of such reagents as soda and hydrochloric acid, eliminated the use of ammonium chloride, and increased the relative yield of strontium. The productivity of carbonate concentrate analysis was increased by a factor of three over analysis of the concentrate from a 100 liter sample. It is pointed out that ^{90}Sr could be determined in two-liter samples of seawater without using a flame photometer. The procedure was also used for analyzing ocean sediments with determination of the ^{90}Sr concentration at the 10^{-12} Ci level. (JPRS)

5211 DETERMINATION OF PLUTONIUM-241 IN EFFLUENTS. Darrall, K. G.; Hammond, G. C. M.; Tyler, J. F. C. (Dept. of Trade and Industry, London). Analyst; 98: No. 1166, 358-363(May 1973).

A method is described for the simultaneous determination of ^{241}Pu and plutonium alpha-activity. The plutonium is isolated by co-precipitation on barium sulphate followed by extraction into bis(2-ethylhexyl) phosphorate, which is incorporated in a liquid scintillator for counting in a liquid scintillation spectrometer. Interferences from α- and β-emitting radionuclides are studied together with interferences from non-radioactive elements. The lower limit of detection is in the region of 1 pCi. (auth)

5212 ISOTOPIC ANALYSIS OF SAMPLES OF RADIOACTIVE FALLOUT AND AEROSOLS USING BETA SPECTROMETRY. Silant'ev, A. N.; Polyakova, T. V.; Rabotnova, F. A.; Shkuratova, I. G. Tr., Inst. Eksp. Meteorol.; No. 25, 136-140(1972). (In Russian).

A method is described for determining the content of ^{106}Ru, ^{144}Pr, ^{90}Y and ^{89}Sr by β spectrometric analysis. A scintillation β-spectrometer with plastic scintillator 70 mm in diameter and 20 mm thick was used as the spectrometer. Only beta emission with energy above 630 keV is considered in processing the spectra. Spectra measured in the range from 630 keV to 3.5 MeV are broken down into intervals, and the system of equations $N_i = \alpha_i^{89}S_{89} + \alpha_i^{90}S_{90} + \alpha_i^{144}S_{144} + \alpha_i^{106}S_{106}$, i = 1, 2, 3, 4 is solved, where N_i is the number of pulses registered in interval i; S is the number of pulses registered in the interval above 630 keV; α_i is a factor for converting from the number of pulses in an interval to the number of pulses registered in the interval above 630 keV; and conversion from the number of pulses registered to the radioactivity of the isotopes can be computed by the formula $N = A_0\epsilon\omega (1 - e^{-\mu d})/\mu d$, where N is the count rate in the interval above 630 keV; A_0 is the activity of the preparation; ϵ is the effectiveness of registration in the interval considered; ω is the solid angle which accounts for angular distribution; d is the thickness of the layer, and μ is the coefficient of attenuation of beta emission. (JPRS)

5213 CHEMICAL CONCENTRATION METHOD FOR THE DETERMINATION ON NIOBIUM, ZIRCONIUM, AND TANTALUM IN CARBON STEEL BY X-RAY FLUORESCENCE SPECTROMETRY. Klima, Z.; Scholes, P. H. (Silesian Univ., Katowice, Poland). Analyst; 98: No. 1166, 351-357(May 1973).

A chemical concentration technique is described for the simultaneous determination of small added amounts of zirconium and niobium (less than 0.05%) and residual amounts of tantalum (less than 0.01%) in carbon steel by x-ray fluorescence spectrometry. Separation from iron and other constituents is effected by precipitation with phenylarsonic acid; the precipitate is then collected on an organic membrane and x-ray measurement made either directly on the precipitate or after pelleting with poly(vinyl alcohol). The results obtained for niobium and zirconium in the test samples compare favorably with published values by other techniques. (auth)

Separation Procedures

Refer also to abstracts 5364, 5530, and 5648.

5214 (CONF-730402-(P1-2), pp 670-679) RECOVERY OF GADOLINIUM AND YTTRIUM VALUES FROM SCRAP GARNET POWDERS. Schultze, L. E.; Bauer, D. J.; Lindstrom, R. E. (Bureau of Mines, Reno, NV). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Yttrium and gadolinium values were reclaimed from electronic garnet scrap by digestion with concentrated sulfuric acid or by roasting with ammonium sulfate. The sulfuric acid treatment was superior because of its consistently higher recovery and greater simplicity. The metal sulfates obtained by treatment with sulfuric acid or ammonium sulfate were leached with water producing an aqueous solution from which mixed yttrium–gadolinium oxalates were obtained by adding oxalic acid. Roasting these oxalates yielded oxides containing only 270 ppM Fe and 80 ppM Al. (auth)

5215 (CONF-730402-(P1-2), pp 1091-1097) FRACTIONAL PRECIPITATION OF RARE EARTH IODATES USING COMPLEXATION HYDROLYSIS OF DIMETHYL SULFATE. Firsching, F. H.; Berger, M. T.; Taylor, P. G.; Thurston, D. W. (Southern Illinois Univ., Edwardsville). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

A new procedure was developed to separate the trivalent rare earths. The rare earth cations are complexed with one of the following chelating agents: DTPA, DCTA, or EDTA. The pH is adjusted to about 3.5, and iodate is then added without causing a precipitate. About one ml of dimethyl sulfate is added and the resulting solution is agitated at room temperature for several hours. As the dimethyl sulfate slowly hydrolyses, the ion concentration gradually increases. Hydrogen ions compete for the chelating agents, which results in a gradual increase in the free rare earth cations. Each chelate formed between each rare earth cation and each chelating agent has a different formation constant. The rare earth cation with the lowest formation constant is selectively released from its chelate as the hydrogen ion concentration is increased. The selectively released rare earth cation then precipitates as the iodate. Coprecipitation of adjacent rare earth cations is significantly decreased. Considerably improved separations have been achieved. (auth)

5216 (COO-1515-38) SELECTIVE SORPTION OF TRACE AMOUNTS OF CALCIUM AND STRONTIUM BY HYDROUS OXIDES OF IRON AND ALUMINUM. Kinniburgh, D. G.; Jackson, M. L.; Syers, J. K. (Wisconsin Univ., Madison). 1973. 34p. Dep. NTIS $3.75.

Heated gibbsite, and freshly prepared Fe and Al gels selectively sorbed traces of Ca and Sr from solutions containing a large excess of $NaNO_3$. The fraction of the total Ca(Sr) sorbed depended principally on the suspension pH, the amount of solid present, and only to a lesser extent on the $NaNO_3$ and Ca concentrations. Significant Ca and Sr sorption occurred on the heated gibbsite, Fe and Al gels, at pH's below their points of zero charge (8.25, 8.05, and 9.40, respectively), indicating specific adsorption. For the heated gibbsite and Fe gel, an empirical model based on the law of mass action fitted the data reasonably well and suggested that for each Ca^{2+} or Sr^{2+} sorbed, about one H^+ was released, thereby leading to an increase in the net positive charge of the surface. Failure of the Al gel to fit the model is probably due to its rapid aging which leads to hysteresis in the sorption-pH curve. (auth)

5217 (COO-1515-47) EXCHANGE OF LYOTROPIC SERIES CATIONS BY MICACEOUS VERMICULITE AND ITS WEATHERING PRODUCTS DETERMINED BY ELECTRON MICROSCOPY AND RADIOCHEMICAL ANALYSIS. Progress Report, August 1, 1972–July 31, 1973. Contract AT(11-1)-1515. 20p. Dep. NTIS $3.00.

Swelling of micaceous vermiculite layers in blister-like areas of lower charge, which occurred in the lyotropic series: $Li^+ > Na^+ > Be^{2+} > Mg^{2+} > Ca^{2+}$, was found to be repressed by fixing monovalent cations. That swelling was not completely prevented was traced, by electron microscopy and electron probe analysis, to trapping of hydrated cations by fixing cations in the order $Cs^+ > Rb^+ > NH^+ > K^+$. Layer charge of biotitic vermiculites, which affects $^{137}Cs^+$ fixation capacity, was unaffected by oxidation and/or reduction of 7 to 90 mmole/100 g of octahedral Fe. The layer charge change mechanism appears to involve tetrahedral Al^{3+}. The presence of ^{238}U fission particle tracks in micaceous vermiculites, observed by scanning electron microscopy, increased the diffusion rate of interlayer K^+, structural Fe (forming crusts on layers) and $Si(OH)_4$, selectivity of K^+ over Ca^{2+}, and cation exchange capacity. Specific sorption of the divalent cations Mg^{2+}, Ca^{2+}, Ba^{2+} and Sr^{2+} on iron and aluminum gels occurred in the presence of 1N $NaNO_3$ with the release of approximately one proton per sorbed ion. The surface meter of a basalt-derived chronosequence of Australian soils was found by oxygen isotope analysis to be ¼ to ½ eolian quartz. Sorption of $^{90}Sr^{2+}$ and $^{137}Cs^+$ was weak in these soils dominated by amorphous material, kaolinite and halloysite. New Zealand chronosequence soils and aerosolic dusts, with abundant micaceous vermiculite, strongly sorbed these isotopes. (auth)

5218 (UCRL-51350) PROCESSING OF LEACH LIQUORS PRODUCED BY NUCLEAR SOLUTION MINING. Miller, J. D. (California Univ., Livermore. Lawrence Livermore Lab.). 15 Feb 1973. Contract W-7405-Eng-48. 20p. Dep. NTIS $4.00.

It appears that solvent extraction represents the most efficacious way to recover copper from leach liquors produced by nuclear solution mining because of the chemical properties of the system as well as the radiochemistry of contaminated solutions. A brief review of the principles of solvent extraction is given, together with a description of commercial copper chelate extractants. The specific extractant that should be used will depend on the temperature and composition of leach liquor generated and to this end guidelines for extractant selection are included. One important consideration with regard to the chemistry of the leach liquor is that, at room temperature, the leach liquor is supersaturated with respect to gypsum. Study of this phenomenon showed that precipitation is slow and takes on the order of several weeks. An inherent advantage of this supersaturation is that coprecipitation of radioactive strontium is normally induced and, as a result, this nuclide should be removed effectively from the aqueous phase before the liquor enters the processing plant. It is anticipated that other nuclides may behave in a similar fashion. Finally, consideration is given to the type of nuclear device that might be used and the associated processing problems with each type. Brief attention is paid to engineering aspects of the system and how the process might be implemented. (auth)

5219 PROCESS OF SEPARATING YTTRIUM FROM LANTHANIDES. Fischer, W.; Schmitt, F. (to Th. Goldschmidt AG.). U. S. Patent 3,721,692. 20 Mar 1973. Filed date 22 Jul 1968. 4p.

A process is presented for separating yttrium from the lanthanides by solvent extraction, in which their thiocyanates are distributed between an aqueous phase and an organic solvent phase, the thiocyanate: lanthanide ratio being at the most equal to the equivalent ratio. The distribution is effected at a temperature below room temperature and preferably between +5° C and the cryohydric point of the aqueous phase. (auth)

5220 AMINO SUBSTITUTED PHOSPHINE OXIDES AS EXTRACTION AGENTS FOR RARE EARTH ELEMENTS. Rusina, M. N.; Polikarpov, Yu. M.; Yaroshenko, G. F.; Timakova, L. M. Zh. Obshch. Khim.; 43: No. 2, 238-242(Feb 1973). (In Russian).

A series of amino-substituted phosphine oxides of different structures were synthesized and used in extraction experiments with rare earth elements from nitric acid solutions. Distribution coefficients, the compositions of the extracted complexes, and the influence of extractant structure on extraction properties were determined. The amino-substituted phosphine oxides, e.g., $(C_6H_5)_2P(O)CH_2N(C_2H_5)_2$ and $(C_6H_5)_2P(O)CH_2CH_2N(C_8H_{17})_2$, exhibited a high extractive efficiency toward the rare earth elements. (KSW)

5221 COLUMN PHENOMENA IN THE GAS-LIQUID CHROMATOGRAPHY OF METAL β-DIKETONATES. Burgett, C. A.; Fritz, J. S. (Ames Lab., IA). J. Chromatogr.; 77: No. 2, 265-276(28 Mar 1973).

Results of studies defining the partitioning and nonequilibrium phenomena observed when mixed-ligand complexes of the lanthanides are gas chromatographed are reported. An equation describing the retention volume of the mixed-ligand complexes is presented in which adsorption at the liquid and solid surfaces and solid-liquid interface are accounted for. Bulk liquid partitioning ratios and solid adsorption coefficients are evaluated. The nature of column loading and displacement is reported to be liquid phase dependent as well as dependent upon the complex itself. (auth)

5222 ISOTACHOPHORESIS ON PAPER. Part I. Investigation of General Conditions and Separation of Some Inorganic Anions. Taglia, V.; Lederer, M. (CNR, Rome). J. Chromatogr.; 77: No. 2, 467-471(28 Mar 1973).

Isotachophoresis was found to be a feasible method for the separation of mixtures of inorganic ions, including CrO_4^{2-}, MoO_4^{2-}, WO_4^{2-}, and ReO_4^- using a simple paper electrophoretic arrangement and with low voltages. Thiosulfate was used as the leading and oxalate as the terminating electrolyte. (JGB)

5223 STUDY OF THE PHYSICOCHEMICAL MECHANISM OF THE SORPTION OF RADIOACTIVE ISOTOPES BY CERTAIN INORGANIC POLYELECTROLYTE MACROMOLECULES. I. Physical and Chemical Sorption by Diatomite, Montmorillonite, Kieselguhr, Silica Gel, Kaolin, and Calcite of the Radionuclides of I, P, Na, Cs, Sr, Ba, Zn, Cu, Co, Mn, and Fe. Furnica, G.; Toader, M.; Turcitu, E.; Bulan, S. (Inst. d'Hygiene et de la Sante Publique, Bucharest). Rev. Roum. Chim.; 18: No. 1, 175-185(Jan 1973). (In French).

Suspensions and sediments from surface basins have the capacity of holding on to numerous radioactive isotopes in aqueous solution. The sorptive capacity was studied for various chemical components of the suspensions and sediments of the surface basins, such as diatomite, montmorillonite, kieselguhr, silica gel, kaolin, and calcite. The radioactive isotopes of the following elements were used: I, P, Na, Cs, Sr, Ba, Zn, Cu, Co, Mn, and Fe. The eluting action of water was also studied for the retention capacity of isotopes by macromolecules to determine the physical or chemical aspect of the sorption of the isotopes by the chemical substances used. (tr-auth)

5224 PURIFICATION OF IODINE BY DIRECTIONAL CRYSTALLIZATION. Kirgintsev, A. N.; Kabysheva, V. I.; Kosyakov, V. I.; Sokolov, V. M. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). J. Appl. Chem. USSR (Engl. Transl.); 45: No. 10, 2272-2274(Oct 1972).

Translated from Zh. Prikl. Khim.; 45: No. 10, 2164-2167(Oct 1972).

Study of the purification of crude iodine and of iodine passed through filters Nos. 1 and 2 by the directional crystallization method showed that the optimal purification conditions are: directional crystallization of iodine, after filtration through a No. 2 filter, without supercooling and with forced agitation of the melt. Under these conditions the yield of iodine of analytical reagent grade is 77%. (auth)

5225 XENON ADSORPTION ON MICROPOROUS SORBENTS. Bering, B. P.; Zhukovskaya, E. G.; Rakhmukov, B. Kh.; Serpinskii, V. V. (Inst. of Physical Chemistry, Moscow). Izv. Akad. Nauk SSSR, Ser. Khim.; No. 2, 468-469(Feb 1973). (In Russian).

Adsorption isosteres of Xe on zeolite NaX and on an active carbon were determined for a broad range of parameters: 125 to 550°K, an equilibrium pressure range of a factor of four, and for filling from 0.01 to 0.97. The experimental results were in good agreement with the calculated temperature dependence of adsorption equilibrium from one isotherm. (KSW)

5226 CONDITIONS FOR THE COMBINED DISTILLATION OF GERMANIUM, SELENIUM, TELLURIUM, AND THALLIUM FROM COPPER PYRITE CONCENTRATES. Angelova, V.; Petkova, E. God. Vissh. Khimikotekhnol. Inst.; 14: No. 2, 139-151(1967). (In Bulgarian).

The separation of Ge, Se, Te, and Tl during the roasting of Cu pyrite concentrates containing Cu 4.98, Fe 33.78, and S 42.97% and Ge 16, Se 190, Te 300, and Tl 110 g/ton was studied. As reducing agents, charcoal or a Ge containing coal was used in a concentrate of 5 to 20% based on the weight of the concentrate. Charges with a moisture content of 18% and containing 3% bentonite were granulated and dried at 160°C for 2 hr to give a crushing strength of 2.4 to 5.1 kg. The reduction took place in a vertical-tube furnace with silite heaters. The results show that removal of Ge is strongly dependent on the roasting temperature. At <800°C, it does not evaporate regardless of the amount of added reducing agent. Over the 800 to 950°C range, the coefficient of separation rises sharply, reaching 94 to 99% at 950°C. The separation of Tl is determined both by the temperature and by the content of charcoal and NaCl. At >800°C, the coefficient of separation, η, is independent of the charcoal concentration and varies from 92 to 97%. The presence of NaCl in the charges accelerates the removal of Tl. Se and Te are practically completely separated >800°C (η = 93 to 97%); η appears to be slightly affected by the concentration of charcoal or NaCl. The degree of desulfuration varies with temperature from 95 to 99.3%. Such high values are attributed to the thermal dissociation of complex sulfides. The air-consumption effect was studied at the optimal roasting temperature (950°C) by using bituminous coal as the reducing agent and at K = 0.5 to 2 (where K is the coefficient of excess air). The η of Ge, Se, Te and Tl is not affected by the air-consumption rate. Optimal separation of these metals is achieved when roasting charges containing 5 to 10% reducing agent at 950°C and at K = 1.0 to 1.5. (Selenium and Tellurium Abstr.)

5227 LIQUID–LIQUID CONTACTING EQUIPMENT. A Brief Review. Warwick, G. C. I. (Power-Gas Ltd., Stockton-on-Tees, Eng.). Chem. Ind. (London); No. 9, 403-408(5 May 1973).

From annual meeting of the Society of Chemical Industry; Leeds, Eng. (11 Jul 1972).

5228 ANION-EXCHANGE BEHAVIOUR OF VARIOUS METALS ON DEAE-CELLULOSE IN MIXED ACETIC ACID–NITRIC ACID MEDIA. Kuroda, R.; Kondo, T.; Oguma, K. (Chiba Univ., Japan). Talanta; 20: No. 6, 533-539(Jun 1973).

A number of nitrato complexes of metals have been found to be adsorbed on diethylaminoethylcellulose from mixed acetic acid–nitric acid media, although none can be adsorbed from aqueous nitric acid solutions. The distribution coefficients of Sc, Mo, La, Sm, W, Re, Bi, Th, and U are given as functions of acetic acid and nitric acid concentrations (sometimes in the presence of hydrogen peroxide to prevent hydrolytic precipitation). For 25 other metals column adsorption behaviour is described for a 90% acetic acid-10% 7.6 M nitric acid mixture. Favorable differences in the distribution coefficients allow useful separations such as Fe–Mo–W and U–Sm–Mo–Bi–Th, to be achieved. (auth)

5229 MECHANISM OF THE SORPTION OF METAL IONS ON CARBOXYLIC ACID CATION-EXCHANGE RESINS. XIV. The Sorption of Microamounts of Uranium(VI), Neptunium(VI), and Plutonium(VI) on SG-1 Resin. Yufryakova, N. K.; Chuveleva, E. A.; Nazarov, P. P.; Chmutov, K. V. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: 11, 1626-1628(Nov 1972).

Translated from Zh. Fiz. Khim.; 46: No. 11, 2861-2864(Nov 1972).

The interaction of microamounts of uranyl, neptunyl, and plutonyl ions with SG-1 carboxylic acid resin was investigated. The nature of complex formation by the uranyl ion with the functional groups of the cation exchanger does not change on passing from macroconcentrations to microconcentrations of UO_2^{2+}. The ions investigated form with the carboxy-groups of the resin complexes of identical composition, the stability of which decreases in the sequence $UO_2^{2+} > NpO_2^{2+} > PuO_2^{2+}$. (auth)

5230 KINETICS OF ION EXCHANGE ON COMPLEX-FORMING RESINS. 1. Kinetics of the Sorption of Uranyl, Sodium, and Barium Ions on Carboxylic and Phosphonic Acid Resins. Chuveleva, E. A.; Nazarov, P. P.; Chmutov, K. V. (Inst. of Physical-Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 11, 1628-1631(Nov 1972).

Translated from Zh. Fiz. Khim.; 16: No. 11, 2865-2869(Nov 1972).

The kinetics of the sorption of uranyl, barium, and sodium ions on the H-forms of the carboxylic acid cation exchangers SG-1 and Amberlite IRC-50 and a phosphonic cation exchanger of type KRF were investigated as a function of the metal concentrations in the initial solution, the grain size, and the degree of cross-linking of the resin. (auth)

5231 SOLVENT EXTRACTION OF MIXED COMPOUNDS OF NIOBIUM WITH 1-PHENYL-3-METHYL-4-BENZOYLPYRAZOLONE-5. Savrova, O. D.; Gibalo, I. M.; Spiridonova, S. S.; Lobanov, F. I. (Moscow State Univ.). Zh. Anal. Khim.; 28: No. 4, 817-818(Apr 1973). (In Russian).

Extraction of niobium(V) catecholate and thiocyanate by benzene solutions of PMBP can be used. Optimal conditions were found for the formation of mixed compounds and ratios of components in the compounds extracted were determined to be Nb : C(SCN^-) : PMBP = 1 : 2 : 1. The effect of W, Zr, Mo, Ta, Fe(III), V on extraction-photometric determination of niobium(V) with C (SCN^-) and PMBP was studied. (auth)

5232 CONCENTRATION AND SEPARATION OF INORGANIC SUBSTANCES BY THE OXIDATION-REDUCTION CHROMATOGRAPHY METHOD. Ol'shanova, K. M.; Morozova, N. M.; Chebotareva, N. I.; Ermakova, P. N. (Moscow Technological Inst. of Meat and Milk Industry). Zh. Anal. Khim.; 28: No. 4, 805-807(Apr 1973). (In Russian).

Oxidation-reduction chromatography on the AV-17 anion exchanger treated with hydrazine was used for concentration and separation of Ce, V, Mn, Fe, and Cr. (auth)

5233 STUDY OF THREE-COMPONENT COMPLEX COMPOUNDS OF SOME RARE EARTHS. Tomilova, L. G.; Efimov, I. P.; Peshkova, V. M. (Moscow State Univ.). Zh. Anal. Khim.; 28: No. 4, 666-670(Apr 1973). (In Russian).

The solvent extraction of compounds of neodymium, gadolinium, and erbium with 1-phenyl-3-methyl-4-benzoylpyrazolone-5 in the presence of tri-n-butyl phosphate, piperidine, and 1,10-phenanthroline was studied. The distribution ratios for the rare earths increase markedly when these substances are added due to the synergistic effect. Extraction constants, composition, and stability of the three-component complexes formed were determined. The increase in the extraction percentage and the stability of the adducts follows the order: TBP, piperidine, 1,10-phenanthroline. (auth)

5234 SOLVENT EXTRACTION OF THIOCYANATE COMPLEXES OF METALS. Sultanova, Z. Kh.; Chuchalin, L. K.; Iofa, B. Z.; Zolotov, Yu. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 28: No. 3, 413-435 (Mar 1973). (In Russian).

Use of thiocyanate systems for separation and determination of different metals is discussed. 409 references. (auth)

5235 SEPARATION OF THE RADIOISOTOPES OF TELLURIUM AND CESIUM BY FRACTIONAL VOLATILIZATION. Babenkov, M. I.; Bobykin, B. V.; Chebotnikov, V. A. pp 156-160 of *Prikladnaya yadernaya spektroskopiya*. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5236 ZIRCONIUM AND SCANDIUM THENOYLTRIFLUOROACETONATE EXTRACTION FROM MINERAL ACID SOLUTIONS

IN THE PRESENCE OF DIAMIDE HEPTYLPHOSPHATE. Putilina, V. S.; Fadeeva, V. I.; Alimarin, I. P. Vestn. Mosk. Univ., Ser. II. Khim.; 14: No. 1, 120-122(1973). (In Russian).

The extraction of mixed zirconium, scandium complexes with heptyl phosphorodiamate and thenoyltrifluoroacetone from solutions of nitric, perchloric and hydrochloric acids was investigated. The increase of scandium extraction yield at acid concentration less than 3M is caused by the substitution of the molecule H_2O for heptyl phosphorodiamate from the coordination sphere of scandium thenoyltrifluoroacetone complex. The increase of scandium and zirconium extraction in strong acid media may be explained by the formation of mixed complexes $MA_{1-n}X_n$ DAΓΦ where X is the anion of a mineral acid. (auth)

5237 PROCEDURE FOR CONCENTRATING NIOBIUM MINERALS BY FOAM FLOTATION. (to Molybdenum Corp.). Belgian Patent 749,551. 24 Apr 1970. (In French).

A process is described for the concentration of a mineral of niobium and tantalum oxides by flotation. It is characterized by the fact that an organic amine is added to the slurry, the amine being chosen from among the amines of high molecular weight and their hydrolyzable salts, a hydrolyzable salt, and a hydrolyzable acid containing the fluoride ion and a wetting agent. The aeration and flotation are carried out in an aqueous slurry having a pH below 7.0. (EJH)

5238 SOLVENT EXTRACTION OF SCANDIUM, THORIUM, AND ZIRCONIUM WITH HEPTYL TETRAETHYLPHOSPHORODIAMIDATE FROM NITRIC ACID SOLUTIONS. Litvincheva, A. S.; Fadeeva, V. I.; Alimarin, I. P. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Khim.; No. 2, 282-286(Feb 1973). (In Russian).

Heptyl tetraethylphosphorodiamidate (HPTD) extracted up to 90 to 95% of Zr and Th from HNO_3 solutions. The extraction curve for Sc was characterized by the presence of a minimum at 3.5 to 8 M HNO_3. Complexes of the following composition were formed in the organic phase: $Sc(NO_3)_3 \cdot HPTD$, $Sc(NO_3)_3 \cdot 2HPTD$, $Th(NO_3)_4 \cdot 2HPTD$, and $Zr(NO_3)_4 \cdot 2HPTD$. Conventional extraction constants were calculated from tracer-concentration studies with ^{46}Sc, ^{234}Th, and ^{95}Zr. That the metal–HPTD bond resided at the phosphoryl oxygen was demonstrated by ir spectra. (KSW)

5239 ION EXCHANGE OF ALKALI ELEMENTS ON GRANULATED COPPER FERROCYANIDE. Shul'ga, E. A.; Vol'khin, V. V.; Zolotavin, V. L.; Kalugina, N. N. (Perm Polytechnic Inst., USSR). J. Appl. Chem. USSR (Engl. Transl.); 45: No. 11, 2588-2591(Nov 1972).

Translated from Zh. Prikl. Khim.; 45: No. 11, 2470-2474(Nov 1972).

Ion exchange of alkali elements and ammonium was studied on two forms of copper ferrocyanide, the compositions of which correspond to the formulas $M_2Cu_5[Fe(CN)_6]_3$, where $M = Rb^+$ or Cs^+, and $M_{1.0}Cu_{5.50} \cdot [Fe(CN)_6]_3$, where $M = Na^+, K^+, Rb^+, Cs^+$. The exchange capacities ϵ of the sorbents, the distribution coefficients K_x and K_d, and the concentration constants of ion-exchange equilibrium $\tilde{K}_{1,2}$ were determined. The dependence of these quantities on the composition and degree of saturation of ferrocyanide sorbents was established, and it was shown that copper ferrocyanide is suitable for exhaustive removal of cesium from rubidium salts. (auth)

5240 CHEMICAL SEPARATION OF SOME HEAVY ELEMENTS FROM PROTON IRRADIATED TUNGSTEN. Newton, G. W. A. (Univ. of Manchester, Eng.); Robinson, V. J.; Skarestad, M.; Hemingway, J. D. J. Inorg. Nucl. Chem.; 35: No. 6, 2035-2042(Jun 1973).

A method is outlined for separating lanthanides, actinides, and the elements Os, Ir, Au, Hg, Tl, and Pb together with their superheavy homologues, from about 30 g of irradiated tungsten metal. This involves anodic dissolution of the tungsten, and near quantitative deposition of the elements of interest onto a molybdenum cathode, followed by conventional chemical separations. Overall chemical yields are given. (auth)

5241 SOLVENT EXTRACTION OF Tm(III) AND In(III) WITH MIXTURES OF N-BENZOYL-N-PHENYLHYDROXYLAMINE AND THENOYLTRIFLUOROACETONE. Le Roux, H. J.; Fouche, K. F. (Univ. of the Orange Free State, Bloemfontein, South Africa). J. Inorg. Nucl. Chem.; 35: No. 6, 2017-2024(Jun 1973).

The extraction behavior of Tm(III) and In(III) into chloroform solutions containing both N-benzoyl-N-phenylhydroxylamine (HB) and thenoyltrifluoroacetone (HA) was investigated. The experimental results for indium can be accounted for quantitatively in terms of the extraction constants for InA_3, InB_3 and the statistically-calculated values for InA_2B and $InAB_2$. Thulium, on the other hand, has higher extractability than the theoretical values obtained from the extraction constants of TmA_3 and TmB_3 and the statistical values for TmA_2B and $TmAB_2$. The additional extractability is due to the formation of the addition compound $TmA_3 \cdot HB$, which is the predominant extractable species at comparatively high acidities (pH = 3.0). At higher pH the chelates TmA_3 and TmB_3, as well as TmA_2B and $TmAB_2$, are also contained in the organic phase. (auth)

5242 ACIDIC ORGANOPHOSPHORUS EXTRACTANTS. Extraction of Molybdenum(VI) by di(2-Ethylhexyl) Phosphoric Acid from Weakly Acid Solutions. Kolarik, Z. (Kernforschungszentrum, Karlsruhe, Ger.). J. Inorg. Nucl. Chem.; 35: No. 6, 2025-2033(Jun 1973).

The distribution of molybdenum(VI) between solutions of bis(2-ethylhexyl) phosphorate in n-heptane and other diluents and weakly acid perchlorate and nitrate solutions was studied as a function of the hydrogen ion, extractant, nitrate, and perchlorate concentrations and of the nature of the diluent. The extraction mechanism and the composition of extracted complexes of Mo(VI) are discussed. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstract 6200.

5243 WATER: A COMPREHENSIVE TREATISE. Volume 1. The Physics and Physical Chemistry of Water. Franks, F. (ed.). New York; Plenum Publishing Corporation (1972). 613p. $37.50.

A review is presented on physical and theoretical techniques that have been and are being applied to studies on the intermolecular nature of water. Data on water under a wide range of conditions are presented. The 14 chapters include discussion of the following topics: the water molecule; theory of hydrogen bonding in water; properties of ice; Raman and ir spectral investigations of water structure, including discussions on intermolecular and intramolecular vibrations of H_2O and D_2O and intramolecular vibrational spectra from HDO in H_2O and D_2O; NMR studies on water and ice; liquid water: dielectric properties, scattering of x-rays, scattering of neutrons, application of statistical mechanics to studies, and acoustic properties; thermodynamic and transport properties of fluid water; water at high temperatures and pressures; and, structural models. (1204 references.) (JGB)

5244 ADVANCES IN INORGANIC CHEMISTRY AND RADIOCHEMISTRY. Volume 14. Emeleus, H. J.; Sharpe, A. G. (eds.). New York; Academic Press, Inc. (1972). 441p. $24.50.

This review is presented under the following chapter titles: the phosphazotrihalides (554 references); low temperature condensation of high temperature species as a synthetic method (143 references); transition metal complexes containing bidentate phosphine ligands (269 references); beryllium halides and pseudohalides (566 references); and, sulfur–nitrogen–fluorine compounds (277 references). Author and subject indexes are included. (JGB)

Chemical and Physicochemical Properties

Refer also to abstracts 5148, 5370, 5379, 6121, 6156, 6162, 6358, and 6396.

5245 (CONF-730402–(P1-2), pp 4-14) COMPOUNDS OF DIVALENT LANTHANIDES AND ACTINIDES. Peterson, J. R. (Univ. of Tennessee, Knoxville). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Although compounds of divalent lanthanides have been known for over sixty years, the first divalent compounds of transuranium elements were reported only recently. The scope of this paper is limited to the salt-like, nonmetallic compounds (notably halides) of divalent lanthanides and actinides (lanacts). Methods of preparation and some properties of these lanact compounds are summarized with particular emphasis on californium dibromide and americium dichloride, dibromide, and diiodide. Finally, the relative stabilities of divalent lanacts are correlated with the results of recent (II)-(III) oxidation potential work, and predictions are made concerning the possible existence of dihalides of promethium and the transcurium elements. (57 references) (auth)

5246 (CONF-730402–(P1-2), pp 15-25) ORGANOLANTHANIDE AND ORGANOACTINIDE CHEMISTRY: ROLE OF THE

F ELECTRONS. Fischer, R. D.; Amberger, H. D. (Univ. Erlangen-Nuernberg, Ger.). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

The angular overlap model is used to interpret and predict ligand field splitting effects occurring at low energies (10–1,000 cm^{-1}). The uranocene complex $U(C_8H_8)_2$ is considered in detail, and crystal field splitting parameters and an angular-overlap diagram are presented for this complex. Two alternative views of the magnetic properties of $U(C_8H_8)_2$ are discussed. (20 references) (DLC)

5247 (CONF-730402–(P1-2), pp 347-353) ORGANOMETALLICS WITH ACTINIDE-TO-CARBON SIGMA BONDS. Marks, T. J.; Kolb, J. R.; Seyam, A. M. (Northwestern Univ., Evanston, IL). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

The stability of alkyl and aryl complexes of uranium, $(\pi-C_5H_5)_3UR$ (R = methyl, etc.), is discussed. The common β-elimination reaction does not occur; instead, decomposition is by either a free-radical homolytic U–C bond scission and abstraction of cyclopentadienyl H, or a concerted elimination of R–H. NMR proton chemical shift data are given for toluene solutions of $(C_5H_5)_3UR$ compounds, and rearrangement of the compounds is discussed. (DLC)

5248 (CONF-730402–(P1-2), pp 856-860) LANTHANIDE AND ACTINIDE CYANIDES. Bagnall, K. W. (Univ. of Manchester, Eng.). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Some of the difficulties in the preparation of cyanides and cyanocomplexes of the lanthanides and actinides are described. Properties of the cyanides of Eu, Yb, Ce, Pr, Sm, and Ho are discussed; their infrared spectra are tabulated. Organolanthanide cyanides are also considered briefly. In the section on actinide cyanides, the synthesis of $UCl_3(CN) \cdot 4NH_3$ and of $(R_2N)_x M(CN)_{4-x}$ is discussed. (9 references) (DLC)

5249 (CONF-730402–(P1-2), pp 871-880) LANTHANIDE AND ACTINIDE PHTHALOCYANINATO COMPLEXES. Lux, F. (Institut fuer Radiochemie, Garching, Ger.). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

A review is presented of studies of phthalocyaninato complexes of lanthanides and actinides. Absorption spectra was used to study these complexes, and models were proposed for their molecular structure. (5 figures, 19 references) (DLC)

5250 (ORNL-TM–4186) REACTIONS OF SODIUM WITH DOWTHERM. Horner, D. E.; Baldwin, W. H. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 11p. AT $4.00.

The results of studies of the reactions of sodium metal with Dowtherm are summarized. Dowtherm has been proposed as the coolant for the Aerojet General Corporation cask concept for shipping irradiated LMFBR fuel elements that have a thin residual film of sodium coating the stainless steel surfaces of the fuel elements. In small-scale laboratory tests, sodium was shown to react readily at temperatures of 200°C and higher with each of the two components of Dowtherm A (biphenyl and diphenyl oxide). The reactions were extremely slow at temperatures as low as 100°C. With biphenyl, sodium is not consumed, but acts as a catalyst for formation of polyphenyls of various chain lengths. These polyphenyls are not soluble in the coolant and form a tenacious coating on the stainless steel that is not dissolved easily with organic solvents. With diphenyl oxide, sodium is consumed in reactions that produce benzene, phenols, tars, etc. The extent of these reactions, therefore, is limited by the small amount of sodium available. Some of the products separate from the coolant as a sludge but do not adhere to the stainless steel. In contacts of sodium with the Dowtherm A mixture, the diphenyl oxide was found to react preferentially; hence the final products are primarily those derived from this reaction. When the sodium was in the form of a thin coat on the stainless steel, the solid reaction products did not adhere to the surface and were mostly soluble in Dowtherm diluted with benzene. (auth)

5251 APPLICATIONS OF RADIOISOTOPES IN POLAROGRAPHY. Lagrou, A.; Verbeek, F. (Univ., Ghent). Anal. Lett.; 6: No. 4, 327-341(Apr 1973).

In radiopolarography the classical polarographic curves are substituted by radioactivity-potential diagrams. The method allows to follow radiometrically typical polarographic phenomena as the occurrence of maxima. As for the diffusion current constant, I, also a relationship between A_d, A_{tot} and the product $m^{2/3}t^{1/6}$ can be derived giving the diffusion activity constant A. Determining experimentally the values of I and A allows to verify the activity recovered by calculating the corresponding value of the faraday constant. The influence of a large excess ($\geq 10^{-2}$ M) of a more readily reducible ion on the electrolytic discharge of an ion reduced at more negative potentials was investigated, showing experimentally an increase of deposition above concentrations of 10^{-2} M. The increase depends on the medium as well as on the nature of the ions involved. (auth)

5252 SODIUM/WATER REACTIONS. Newman, R. N.; Pugh, A. R.; Smith, C. A. (Central Electricity Generating Board, Berkeley, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 2, 261-263(Apr 1973).

A brief description is given of an investigation into the explosive interaction of sodium samples submerged in water. The sequence of events leading to the explosion is postulated. (UK)

5253 COMPLEXES OF SCANDIUM, YTTRIUM, AND LANTHANUM WITH CHROMAZUROL S AND 1,10-PHENANTHROLINE. Ganago, L. I.; Alinovskaya, L. A. (Inst. of Physics of Solids and Semiconductors, Minsk). Zh. Anal. Khim.; 28: No. 3, 494-499 (Mar 1973). (In Russian).

Ions of Sc, Y, and La form mixed complex compounds with chromazurol S and 1,10-phenanthroline. Ratios of metal: chromeazurol S and metal: 1,10-phenanthroline were determined by the continuous variations, molar ratio, and slope methods. The number of hydrogen atoms displaced by Sc, Y, and La ions from a chromeazurol S molecule was determined. A $MeOH^{2+}$ cation displaces one hydrogen atom from each chromeazurine molecule and coordinates it in case of all the metals studied. The instability constants for the complex compounds of Sc, Y, and La are 1.06 × 10^{-11}, 3.15 × 10^{-13}, and 1.34 × 10^{-8} respectively. (auth)

5254 MEASUREMENT OF TRANSFER NUMBERS IN NONAQUEOUS SOLVENTS OF LOW DIELECTRICITY CONSTANTS BY MEANS OF ALPHA AND WEAK BETA EMITTERS. Marx, G.; Vehlow, J. (Freie Univ., Berlin). (1972). 9p. (In German).

From meeting of lecturers in chemistry; Heidelberg, Germany (10 Apr 1972).

A description is given of a method to determine transfer numbers, the basis of which is the migration of a boundary layer in the electric field generated between a nonradioactive and a radiolabelled solution. This movement can be followed using special detectors. In order to be able to measure radiation of low energy and range (α- and β-emitters), a transfer device is used that consists entirely of the plastic scintillator material NE 102A. Experimental tests of the scintillation properties of the detector as well as of the accordance with theoretical principles are described, the method was applied to the system $[(C_2H_5)_4N]I$ in n-butanol, labelled with ^{14}C. A $[(C_2H_5)_4N]^+$ ion transfer number of 0.5146 ± 0.03% for infinite dilution has been determined, which leads to the single ion conductivity of the I^- ion in n-butanol at 25°C being 9.71 cm^2 ohm^{-1} val^{-1}. (GE)

5255 PRESSURE-DEPENDENT ULTRASONIC ABSORPTION AND VOLUME VISCOSITY IN HEAVY WATER. Kor, S. K.; Singh, G. L.; Pandey, S. K. (Univ. of Allahabad, India). Z. Phys. Chem. (Frankfurt); 85: No. 5-6, 225-229(1973).

The Hirai and Eyring concept of holes in the lattice model of liquid structure has been employed to evaluate pressure dependent volume viscosity and the excess ultrasonic absorption in heavy water at 30°C. The results have been compared with those for water, and the observed difference in behavior at lower pressures of the classical and volume contribution to absorption is attributed to the abnormal increase of the density of D_2O with increasing pressure. (GE)

Isotope Effects

5256 (CONF-730402–(P1-2), pp 1068-1079) MASS SPECTROMETRIC ANALYSIS OF RARE-EARTH ELEMENTS CONTAINED IN VERY SMALL QUANTITIES OF LUNAR SAMPLES: IMPLICATIONS FOR COSMOCHEMISTRY. Long-Den Nguyen (Institut de Physique Nucleaire, Orsay, France); de Saint Simon, M.; Puil, G.; Yokoyama, Y. 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Analysis of seven rare earths (Nd, Sm, Eu, Gd, Dy, Er, Yb) is extended to La and Lu, and use is made of new standard and spike solutions to guard against atmospheric contamination. Results are compared for Luna 20, Apollo 11 to 15, and Luna 16. The Eu depletion in the moon is remarked upon. (10 references, 7 figures) (DLC)

5257 (FRNC-TH-315) ISOTOPIC EFFECTS WITH ^{14}C: NATURE OF THE TRANSITION STATE IN VARIOUS CASES OF PHENYL MIGRATION. Laureillard, J. (Lyon Univ. (France)). 1972. 133p. (In French). Dep. NTIS (U. S. Sales Only) $8.75. Thesis.

The isotopic ^{14}C effect determined and the kinetics of the alkaline hydrolysis and solvolysis of 1,1,2-triphenyl-2-bromo-2-ethanol (^{14}C) in a water–dioxane solvent medium (20% water by volume) with NaOH were studied. The secondary reactions taking place during the solvolysis are described together with the separation of the products obtained after evaporating the organic solvents. Stereochemical studies demonstrated that in the transition state corresponding to the solvolysis of 1,1,2-triphenyl-2-bromo-2-ethanol, the $C\beta$-C_6H_5 rupture is almost complete. This implies a strong C_6H_5-$C\alpha$ bond and a weak $C\alpha$-Br bond. The ^{14}C effect and the kinetics of the argentic dehalogenation of 1,1,2-triphenyl-2-bromo-2-ethanol in the water–dioxane mixture in the presence of $AgNO_3$ were studied together with the products formed. The transition state involves very weak C_6H_5-$C\alpha$ and $C\alpha$-Br bonds and not the breaking of $C\beta$-C_6H_5. The isotopic ^{14}C effect and the kinetics of the dehydration of 3-phenyl-3-methyl-2-butanol were then studied. The $C\beta$-C_6H_5 bond is not broken. The syntheses of the different products studied are then presented. (FR)

5258 REACTION OF CYANOGEN AND HYDROGEN BEHIND REFLECTED SHOCK WAVES. Brupbacher, J. M.; Kern, R. D. (Louisiana State Univ., New Orleans). J. Phys. Chem.; 77: No. 11, 1329-1335(24 May 1973).

The metathetical reaction, $C_2N_2 + H_2 \rightleftharpoons 2HCN$, was studied by shocking equimolar amounts of the reactants in the presence of an inert gas diluent over the temperature range 1850 to 2650°K. A complementary shock tube facility was utilized to obtain the data from the reflected shock zone by recording the infrared emission of HCN and the time-resolved mass spectra at m/e 27 (HCN) and 52 (C_2N_2). The total density variation was 1.8 to 4.4×10^{-6} mol/cm^3. Observation times were typically 500 µsec during which period an equilibrium condition was established for the higher temperature experiments. The growth of the mole fraction of HCN, f_{HCN}, was found to be a nonlinear function of time and to depend upon the inert gas concentration, [M]. The data from the two independent techniques of ir emission and mass spectrometry were fitted to the bimolecular rate expression that includes the back reaction, $\ln\{[(K-4)f_{HCN}-(K+2K^{1/2})]/[(K-4)f_{HCN}-(K-2K^{1/2})]\} = 4k_1[C_2N_2]_0[M]^{0.75}K^{-1/2}t^2 + \ln([K+2K^{1/2})/(K-2K^{1/2})]$, where the forward rate constant is given by $k_1 = 10^{25.35\pm0.21}\exp(-61{,}610 \pm 2070/RT)$ cm^3 mol^{-1} sec^{-2} $[M]^{-0.75}$. These results rule out the direct bimolecular reaction. This complex reaction is discussed in terms of an atomic mechanism and a mechanism involving vibrationally excited species. Experiments on an equimolar mixture of cyanogen and deuterium revealed a lowering of the preexponential factor in reasonable agreement with that predicted from the square root of the inverse ratio of reduced masses. (auth)

5259 LIFETIMES OF THE TRIPLET STATES OF PARTIALLY DEUTERATED TRANS-STILBENES AND STRUCTURALLY RELATED COMPOUNDS. Heinrich, G. (Kernforschungszentrum, Karlsruhe, Ger.); Guesten, H.; Mark, F.; Olbrich, G.; Schulte-Frohlinde, M. Ber. Bunsenges. Phys. Chem.; 77: No. 2, 103-108(1973). (In German).

The triplet lifetimes of phenanthrene, phenanthrene-9-D_1, phenanthrene-D_{10}, 2-phenylindene, 5: 10-dihydroindeno-2(2: 1-a)-indene, trans-stilbene, perdeuterostilbene, and eight partially deuterated trans-stilbenes were measured by flash photolysis in EPA at 77°K. The triplet lifetime is prolonged by deuteration and depends on the number and the position of the deuterium atoms in the molecules. The effect of deuterating an olefinic hydrogen atom in trans-stilbene on the nonradioactive process is 16 times larger than that of deuterating an aromatic position. The effect of the deuterium or hydrogen substitution is additive. CNDO-calculations support the assumption that the isotope effect will be greatest when a large local π-amplitude coincides with a large CH out-of-plane bending amplitude of the C–H bond of the olefinic double bond. This view is supported by a comparison of the data of trans-stilbene with those of electronic model compounds for stilbene. (GF)

5260 QUESTION OF A $^{10}B-^{11}B$ PRIMARY ISOTOPE EFFECT UPON BORON NUCLEAR SHIELDING. McFarlane, W. (Polytechnic, London). J. Magn. Resonance; 10: No. 1, 98-99(Apr 1973).

Although secondary isotope effects have been observed frequently in NMR spectroscopy reports of primary isotope effects (i.e., ones in which isotopic substitution affects directly the NMR parameters of the substituted nucleus), they are much less common. A report is presented on an extremely small $^{10}B-^{11}B$ primary isotope effect upon the boron shielding in the symmetrical ions BH_4^- and BF_4^- in which quadrupole-induced line broadening effects are absent. (UK)

5261 ANOMALOUSLY LOW DIMERIZATION CONSTANT OF $H_2{}^{18}O$. Pinchas, S. (Weizmann Inst. of Science, Rehovoth, Israel). Nature (London) Phys. Sci.; 242: No. 116, 46-47(19 Mar 1973).

It has been observed that ^{18}O-labelled compounds behave anomalously in many respects, indicating that, for some as yet unclear reason, the electronic distribution of the ^{18}O atoms is significantly different from that of ^{16}O atoms, contrary to the usual behavior of isotopic atoms. It was found that the electric dipole movement of 0.6 to 2.3 M solutions of $H_2{}^{18}O$ in dioxane appears to be lower than that of the corresponding $H_1{}^{16}O$ solutions, although the dipole movement of very dilute, and therefore practically monomeric $H_2{}^{18}O$ solutions is somewhat higher than that of the corresponding $H_2{}^{16}O$ solutions. This has been attributed to weaker dimerization of the $H_2{}^{18}O$ molecules compared with $H_2{}^{18}O$ molecules in 0.6 to 2.3 M solutions. To check the correctness of this assumption the mean $(H_2O)_n$ molecular weight of 0.035 to 0.652 M $H_2{}^{16}O$ and $H_2{}^{18}O$ solutions in dioxane was measured cryoscopically and from the results the degree of association of these solutions, and hence the dimerization constants of $H_2{}^{16}O$ and $H_2{}^{18}O$ in dioxane, were calculated: It was clear that the dimerization constant of $H_2{}^{16}O$ was much larger than that of $H_2{}^{18}O$. Since dimerization of H_2O reflects mainly the interaction between the water protons and the lone electron pairs of the H_2O oxygen atoms the results prove that the distribution of these electrons of $H_2{}^{18}O$ is significantly different from the corresponding electron distribution of $H_2{}^{16}O$, and it seems that this difference lies in a relatively larger mean radius for the orbitals of the ^{18}O electrons, as indicated by the higher dipole movement of monomeric $H_2{}^{18}O$. This must bring about a relatively lower charge density for these electrons in ^{18}O-labelled compounds, and hence a lower tendency of these compounds to form H-bonds with protons. (UK)

5262 REACTION OF n-PROPYL RADICALS WITH OXYGEN, HYDROGEN, AND DEUTERIUM. Baldwin, R. R.; Walker, R. W.; Yorke, D. A. (Univ. of Hull, Eng.). J. Chem. Soc., Faraday Trans., I; 69: No. 4, 826-832(1973).

n-C_3H_7 radicals were produced by the oxidation of n-C_3H_7CHO at 450°C. By measuring the relative yield of C_3H_6 and C_3H_8, a value for the ratio $k_4/k_1 = 0.040 \pm 0.005$ was obtained. A value of k_4 can be obtained, based on the value of 2.9×10^{10} 1.mol^{-1}s^{-1} assumed for the combination of two C_3H_7 radicals, which gives $k_1 = 3.1 \times 10^7$ at 450°C. By measuring the increased yield of C_3H_8 (or C_3H_7D) in the presence of H_2 (or D_2), the ratios $k_1/k_2 = 347 \pm 10$, $k_2/k_3 = 2.3 \pm 0.2$ at 450°C are obtained. n-$C_3H_7 + O_2 \rightarrow C_3H_6 + HO_2$ (1) n-$C_3H_7 + H_2 \rightarrow C_3H_8 + H$ (2) n-$C_3H_7 + D_2 \rightarrow C_3H_7D + D$ (3) n-$C_3H_7 + C_3H_7CHO \rightarrow C_3H_8 + C_3H_7CO$.(4). The value for k_2/k_3 suggests that $E_3 - E_2 = 0.7$ kcal mol^{-1} which indicates a lowering of the zero-point energy in the transition state by about 1.1 kcal mol^{-1} when H_2 is replaced by D_2. Using entropy data, and the Arrhenius parameters for reaction (–2) (i.e. $H + C_3H_8 \rightarrow CH_3CH_2CH_2 + H_2$), $A_2 = 2.6 \times 10^9$ and $E_2 = 14.8$ kcal mol^{-1}. (auth)

5263 ESTIMATE OF THE KINETIC ISOTOPE EFFECT IN RADICAL REACTIONS. Galinov, E. M. (Moscow Inst. of the Petrochemical and Gas Industry). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 11, 1648-1649(Nov 1972).

Translated from Zh. Fiz. Khim.; 46: No. 11, 2899-2901(Nov 1972).

The relation between the kinetic isotope effect in a free radical reaction and the equilibrium constant of the corresponding isotope exchange reaction was obtained on the basis of the familiar empirical relation between the activation energies and heats of radical reactions. The kinetic isotope effect in endothermic radical reactions has a sign opposite to that of the corresponding thermodynamic isotope effect, while in exothermic reactions the signs are the same. Analysis of the expressions obtained also shows that the absolute values of the kinetic isotope effects in radical reactions are lower than the corresponding values of the thermodynamic isotope effects and much lower than the kinetic isotope effects in the usual dissociative reactions. (auth)

5264 ACCURACY OF THE CALCULATION OF THERMODYNAMIC ISOTOPE EFFECTS IN TERMS OF THE RIGID ROTATOR HARMONIC OSCILLATOR APPROXIMATION. Ivlev,

A. A. (Moscow Inst. of the Petrochemical and Gas Industry). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 11, 1563-1566(Nov 1972).

Translated from Zh. Fiz. Khim.; 46: No. 11, 2733-2738(Nov 1972).

An analytical expression was obtained whereby the absolute error of the calculation of the β-factor, due to the variation of the force constants, may be estimated. A relation was discovered between the $\Delta\beta$ and a number of parameters entering into the above expression. An approximate estimate was obtained of the dependence of β on the accuracy of the calculation of the frequencies in different parts of the spectrum. Certain recommendations are made concerning the calculation of β factors for organic molecules. (auth)

5265 DEUTERIUM ISOTOPE EFFECTS ON THE SECOND VIRIAL COEFFICIENT OF METHANE. Fang, A. Y. H. Knoxville, TN; Univ. of Tennessee (1972). 122p. University Microfilms Order No. 73-12,403.

Thesis (Ph.D.).

Isotope effects on the gaseous second virial coefficients of the deuterated methanes: CH_4, CH_3D, CH_2D_2, CHD_3, and CD_4 were investigated. The measurements were made by means of differential expansion over a range of temperature extending from 110°K up to 300°K. Isotope effects on the second virial coefficients contain translational, rotational and internal contributions. The former, commonly called the "quantum contributions" are only important at low temperatures. The most important contribution to the latter appears to be due to the isotope effect on the polarizability and the value for this effect which is extracted from the data is consistent with that derived from Raman spectral intensities and from the isotope effect on the refractive index. (Diss. Abstr. Int., B)

5266 ELEMENTARY SEPARATION FACTORS OF CALCIUM ISOTOPES IN ION-EXCHANGE EQUILIBRIA SUPPORTED BY COMPLEXING AGENTS. Heumann, K. G. (Technische Univ., Darmstadt, Ger.). (1972). 7p. (In German).

From meeting of lecturers in chemistry; Heidelberg, Germany (10 Apr 1972).

In order to gain a better knowledge of isotope effects in ion-exchange equilibria, the following systems were studied: 1) heterogeneous exchange systems of calcium with chelate exchangers (Dowex A1–CaCl solutions and chelate exchangers on the basis of o-(2-hydroxyphenylazo)benzoic acid–NH_4Cl solutions) and 2) heterogeneous exchange systems of calcium with complexing solutions (Dowex 50 × 12–EDTA or α-hydroxyisobutyric acid or citrate solutions). It was demonstrated that changing the amount of calcium in the solution relative to that in the solid phase, the isotope effect can be completely shifted to one phase, with the isotope ratio in the other phase tending to zero. Hence the analysis of the isotope ratio of only one phase has to be done (by mass spectrometry) in order to be able to determine the elementary separation factor. In the systems mentioned above, the elementary separation factors were determined by the batch method and lie between 1.005 and 1.019 for $^{44}Ca/^{40}Ca$, and between 1.008 and 1.036 for $^{48}Ca/^{40}Ca$. (GE)

5267 PROTON INVENTORIES OF TRANSITION STATES FOR SOLVATION CATALYSIS AND PROTON-TRANSFER CATALYSIS. Decomposition of the Tetrahedral Intermediate in Amide Methanolysis. Hopper, C. R.; Schowen, R. L.; Venkatasubban, K. S. (Univ. of Kansas, Lawrence). J. Amer. Chem. Soc.; 95: No. 10, 3280-3283(16 May 1973).

The second-order rate constants, k_n, for methoxide-catalyzed methanolysis of $CF_3CON(CH_3)C_6H_4X$ in binary mixtures of CH_3OD (mole fraction n) and CH_3OH (mole fraction 1 − n) are described by the equation, $k_n = k_0(1 - n + \phi^*n)(1 - n + 1.2n)^2/(1 - n + 0.74n)^3$, where $\phi^* = 0.39$ (X = m-NO_2), 0.29 (X = p-Cl), and 0.13 (X = p-OCH_3). The tetrahedral intermediate decomposes with proton-transfer catalysis in the p-OCH_3 case ($k_H/k_D = 7.4[\equiv(\phi^*)^{-1}]$) and with solvation catalysis in the m-NO_2 case ($k_H/k_D = 2.6$), the isotope effects referring solely to the proton bridging the core, or substrate portion, of the transition state to the catalytic entity. The latter may contain two "gas-like" methanol molecules ($\phi_m = 1.2$) deriving from nonequilibrium solvation of the transition state. (auth)

5268 PROTON AFFINITIES OF HYDROGEN AND WATER FROM ENDOTHERMIC ION-MOLECULE REACTIONS OF H_2O AND D_2O WITH MOLECULAR HYDROGEN. Cotter, R. J. Baltimore; Johns Hopkins Univ. (1972). 161p. University Microfilms Order No. 73-12,127.

Thesis (Ph. D.).

The cross section of the ion–molecule reaction: $D_3O^+ + D_2 \rightarrow D_3^+ + D_2O$, was studied over a wide range of primary ion energies using a tandem mass spectrometer. The reaction is endothermic and the energy threshold, after correction for Doppler-broadening effects, was taken to correspond to the heat of reaction. From this, the PA(H_2O) was determined to be 7.20 ± 0.10 eV. The method was further tested using the endothermic reaction: $H_2O^+ + H_2 \rightarrow H_3^+ + OH$ and its deuterium counterpart. The PA(H_2) and the DA(D_2) were determined as 4.37 ± 0.05 eV and 4.50 ± 0.05 eV respectively, and give a reasonable correspondence with recent determinations. In addition, this work also investigates reaction mechanisms, isotopic effects, and excited state formation in the hydronium ion beam. Information on the latter may serve to explain the wide range of values of PA(H_2O) reported by earlier investigators. (Diss. Abstr. Int., B)

5269 VIBRATIONAL SPECTRA OF TRICHLOROMETHOXYSILANE AND ITS DEUTERIUM ANALOG. Fedoseeva, V. I.; Pentin, Yu. A. Vestn. Mosk. Univ., Ser. II. Khim.; 14: No. 1, 104-105(1973). (In Russian).

The infrared and Raman spectra of trichloromethoxysilane were measured and the assignment of frequencies was given. The normal coordinate treatment was carried out for both compounds. The force field was obtained by the successive consistency technique. (auth)

5270 QUANTUM MECHANICAL COMPUTATIONAL STUDIES OF CHEMICAL REACTIONS. 2. Isotopic Exchange Reactions for the Collinear H + H_2 system. Wu, S. F.; Johnson, B. R.; Levine, R. D. (Ohio State Univ., Columbus). Mol. Phys.; 25: No. 3, 609-630(Mar 1973).

A computational study of the kinetic isotope effects of various isotopic reactions for the H + H_2 system was made on the level of collinear reactions using fully converged quantum results in the total energy range of 8 to 25 kcal/mole. The Porter–Karplus surface of H_3 was used. No substantial amount of reaction probability was found for total energy below the potential energy barrier, $V_1(s\ddagger) = 9.13$ kcal/mole. (Note: ‡ is used to designate the parameters of the transition state.) It was shown that quantum corrections for the "tunnelling effect" should be based on an effective potential, namely $[V_1(s) + \epsilon_0(s)]$, by including the zero-point vibrational energy ($\epsilon_0(s)$) of ρ-motion perpendicular to the reaction paths and the dynamic effects due to the curvature of the reaction coordinate. The transmission coefficients for these isotopic reactions were calculated in the temperature range of 200 to 1300°K. It was found that their magnitudes were large and approximately the same for the isotropic reactions investigated here, reflecting the similar quantal threshold behaviors of the reaction probability. The major source of the isotope effect in the (collinear) rate constant, is thus the easily understood difference due to changes in the reduced masses and the zero-point energies. Previously reported resonances in reactive molecular collisions for the H + H_2 system are demonstrated by the presence of resonance circles in the complex plane representation of the transition probability amplitudes. The nature of the dynamic potentials supporting the threshold resonance was explored in a study of one-state approximations. (auth)

5271 VAPOUR PRESSURE OF NORMAL AND HEAVY WATER FROM 273.15 TO 298.15 K. Besley, L. (National Standards Lab., Chippendale, Australia); Bottomley, G. A. J. Chem. Thermodyn.; 5: No. 3, 397-410(May 1973).

Eighty-two measurements of the vapor pressure of degassed normal water between 273.15 and 298.15°K are reported, together with 37 values for D_2O (purity: 99.75 mass %) from 277.15 to 298.15°K. Fitting equations are given and the interpolated values are cited at 1°K intervals. Comparisons are made with extant data which suggest that, especially for D_2O, these properties are not yet sufficiently well established. (auth)

5272 TEMPERATURE DEPENDENCE OF SOME SECONDARY KINETIC DEUTERIUM ISOTOPE EFFECTS. Kang, U. G. East Lansing, MI; Michigan State Univ. (1972). 75p. University Microfilms Order No. 73-12,749.

Thesis (Ph. D.).

In an effort to understand the origin of isotope effects, Karabatsos and his coworkers measured several isotope effects as functions of temperature. They found that both $\Delta\Delta H^\ddagger$ and $\Delta\Delta S^\ddagger$ contribute to the isotope effects. They usually have the same sign, which results in smaller isotope effects due to cancellation. Their preliminary results indicated that in correlating isotope effects and reaction mechanisms the $\Delta\Delta H^\ddagger$ term is more significant than the $\Delta\Delta G^\ddagger$ term. Furthermore, within the limits of accuracy imposed by the assumptions of Bartell's procedure, a comparison of calculated isotope effects ($\Delta\Delta E$), due only to nonbonded interactions, with experimental values of $\Delta\Delta H^\ddagger$ indicates that in ordinary systems with hyperconjugation possible, hyperconjugation is the dominant contributor to $\Delta\Delta H^\ddagger$. In the nucleophilic hydrolyses of acid chlorides and esters, the isotope effects due to $\Delta\Delta G^\ddagger$ are nearly unity. However, in the activation process the force constants should increase, because the demand for hyperconjugation decreases and nonbonded interactions increase. Therefore, an inverse isotope effect ($k_H/k_D < 1$) is expected. Indeed, the $\Delta\Delta H^{\ddagger}$ term is reasonably large and positive leading to an inverse isotope effect. The experimental isotope effect is only near unity because of cancelling contributions to $\Delta\Delta G^{\ddagger}$ from $\Delta\Delta S^{\ddagger}$ and $\Delta\Delta H^{\ddagger}$. From the results of the present study, the negative $\Delta\Delta H^{\ddagger}$ value (−123 cal/mole in 65% acetone–water and −114 ± 6 cal/mole in 70% acetone–water) is reasonable in view of the near limiting character of the solvolysis of the 8-methyl-1-naphthoyl chloride in 65% and 70% acetone–water. The much less negative values in 75%, 80% and 85% acetone–water (−23 ± 14, −27 ± 58 and −10 ± 18 cal/mole respectively) are consistent with the borderline character of acid chloride solvolysis and indicate less limiting character in these solvents. However, the isotope effects due to $\Delta\Delta G^{\ddagger}$ (k_H/k_D = 1.014 ± .003 in 85% A/W −20.60°; and 1.023 ± .006 in 70% A/W, −20.60°) show their insensitivity to changes in reaction mechanism. They result from the cancelling contributions of the $T\Delta\Delta S^{\ddagger}$ and $\Delta\Delta H^{\ddagger}$ terms ($\Delta\Delta H^{\ddagger} = -114 \pm 6$ cal/mole and $\Delta\Delta S^{\ddagger} = -0.4 \pm .0$ e.u. in 70% A/W; $\Delta\Delta H^{\ddagger} = -10 \pm 18$ cal/mole, $\Delta\Delta S^{\ddagger} = 0.0 \pm .0$ e.u. in 85% A/W) to $\Delta\Delta G^{\ddagger}$. (Diss. Abstr. Int., B)

5273 HEAVY ATOM KINETIC ISOTOPE EFFECTS. Pt. 2. Nitrogen Isotope Effects in the Decomposition of Aqueous Aromatic Diazonium Salts. Loudon, A. G.; Maccoll, A.; Smith, D. (University Coll., London). J. Chem. Soc., Faraday Trans., I; 69: No. 5, 899-903(1973).

The rate constant ratio $^{14}k/^{15}k$ was determined for the decomposition of some diazonium fluoroborates in aqueous solution in both the presence and absence of added salts. (^{14}k and ^{15}k refer to those isotopic species in which the diazonium group is attached to the phenyl group via a ^{14}N and ^{15}N respectively). The implications of the results for the mechanism of these reactions are discussed. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstract 5364.

5274 (FRNC-TH-322) CARBON-14 LABELLED AMINO-ACIDS, AMINOKETOACIDS, AND AMINOKETONES OF INTEREST IN BIOLOGY. Beaucourt, J. P. (Paris Univ., Orsay (France)). 1972. 274p. (In French). Dep. NTIS (U. S. Sales Only) $15.75. Thesis.

Four methods of synthesizing (^{14}C-4 or ^{14}C-5) labelled delta aminolevulinic acid from the following reagents are presented: trimethylsilyl (TMS) malonate, 2,4,10-trioxa-adamantane group, 2,4,10-trioxaadamantane group and the acetamido (TMS) malonate or 2,4,10-trioxaadamantane and 1,3-dithiane groups. The 2,4,10-trioxaadamantane group was used for the synthesis of amino acids such as (^{14}C-4) homoserine, (^{14}C-4) methionine, or esters (^{14}C-4 γ butyrolactone). The generalization of the utilization of TMS malonate for the synthesis of (^{14}C)β-ketonic esters and (^{14}C)α-ketonic amines from (^{14}C) carboxylic acids is described. The synthesis of (^{14}C-7) adrenalone, (^{14}C) ketones,, (^{14}C) ketonic acids, and (^{14}C-4) 4-keto ornithine is presented. (FR)

5275 (UCLA-34-P-102-36) OCCURRENCE AND CHARACTERISTICS OF ^{18}O-EXCHANGE REACTIONS CATALYZED BY SODIUM- AND POTASSIUM-DEPENDENT ADENOSINE TRIPHOSPHATASES. Dahms, A. S.; Boyer, P. D. (California Univ., Los Angeles). 1972. Contract AT(04-3)-34. 43p. Dep. NTIS $4.25.

Microsomal preparations of the (Na^+, K^+)-ATPase from porcine outer medulla and electroplax catalyzed a rapid Mg^{2+}- and K^+-dependent exchange of water oxygens with inorganic phosphate in the absence of ATP or ADP. Exchange activity was unaffected by uncouplers and inhibitors of oxidative phosphorylation but was inhibited by Na^+, ouabain, N,N′-dicyclohexylcarbodiimide, or p-mercuribenzoate. No nucleotide requirement for the exchange could be demonstrated. Addition of ATP to a Na^+-inhibited system resulted in an exchange of oxygens of medium P_i concomitant with ATP hydrolysis. This ATP-induced exchange amounted to 1.5 oxygen atoms per P_i released. Neither ADP nor adenylyl methylene diphosphonate would serve to activate the exchange. Treatment of the preparations with deoxycholate apparently uncoupled the medium $P_i \rightleftharpoons HOH$ exchange but was without affect on the ATP-induced exchange. The data suggest that the exchange arises by partial reversal of a late step in ATP hydrolysis by the (Na^+, K^+)-ATPase. (auth)

5276 ROLE OF SINGLET AND TRIPLET STATES IN AROMATIC SUBSTITUTION REACTIONS. II. Fluorescence Quenching of Anisole and P-Hydroquinone by Acids. Vesley, G. F.; Olafson, B. D. (Univ. of North Dakota, Grand Forks). J. Phys. Chem.; 77: No. 11, 1345-1347(24 May 1973).

Fluorescence quenching data using various acids and solvents for anisole and p-hydroquinone are presented in an effort to determine the mechanism of the photochemical hydrogen–deuterium in Aromatic Systems. The quenching rate shows a large dependence on the acid used ($CF_3CO_2H > HCl$) indicating participation of the anion or undissociated acid. The quantum yield for exchange in THF is measured as 0.008 and complications in this reaction are indicated. (auth)

5277 EXCHANGE WITH DEUTERIUM AND ISOMERIZATION OF SOME ALKENES CATALYSED BY GALLIUM OXIDE. Carleton, F. B.; Quinn, H. A.; Rooney, J. J. (Queen's Univ., Belfast). J. Chem. Soc., Chem. Commun.; No. 7, 231-232(4 Apr 1973).

Gallium oxide catalyses with high selectivity the exchange with deuterium of vinylic and allylic hydrogens in a variety of alkenes, and directly interconverts cis and trans isomers of butenes and pentenes at temperatures well below those required for double-bond shift. (auth)

5278 ISOTOPIC VARIATIONS OF NATURAL CALCIUM IN RECENT CARBONATES AND SULPHATES. Heumann, K. G.; Lieser, K. H. (Technische Univ., Darmstadt, Ger.). Geochim. Cosmochim. Acta; 37: No. 6, 1463-1471(Jun 1973). (In German).

Investigations of isotopic variations of calcium were carried out. For that purpose natural calcium carbonate and calcium sulfate samples were analyzed. The isotopic ratios $^{44}Ca/^{40}Ca$ and $^{48}Ca/^{40}Ca$ were measured with a mass spectrometer by thermal ionization. The precision of the isotopic abundance measurements was better than 1% per mass unit. It was concluded from the results that in general chemical exchange reactions of calcium ions which imply isotopic fractionation do not take place in nature. Only in the case of one sample ("Gipsrose") an isotopic variation of calcium was found. This fractionation can be explained by ion exchange or different diffusion rates of the calcium isotopes. (auth)

5279 OXYGEN-ISOTOPE VARIATIONS IN SULFATE IONS IN THE WATER OF SOME ITALIAN LAKES. Cortecci, G. (Laboratorio di Geologia Nucleare, Pisa, Italy). Geochim. Cosmochim. Acta; 37: No. 6, 1531-1542(Jun 1973).

The results obtained by measuring the sulfate content and its $^{18}O/^{16}O$ ratios through time in some volcanic, tectonic and dam Italian lakes are reported. The variations with time of the oxygen isotopic composition of the lake waters are also reported. The measurements refer mainly to surface water; however, a few deep samples were also studied. In the case of all the lakes examined, the variations with time of the oxygen isotopic composition and of the concentration of the dissolved sulfate cannot be explained in terms of the addition and of seasonal variations of the ^{18}O content of rainwater sulfate. Biological redox processes involving bacterial reduction of sulfate and sulfide oxidation can reasonably account for the results obtained. According to Lloyd (Science; 156 : 1228-1231(1967)), when sulfate is formed by bacterial sulfide oxidation, 68% of the sulfate oxygen is water oxygen while 32% is dissolved molecular oxygen. The isotopic enrichment of the dissolved molecular oxygen in the lake waters relative to the isotope content of the atmospheric oxygen is mainly related to the biological activity in the waters. Assuming that a stagnation period takes place during summer and fall while a period of strong bio-respiratory activity takes place during winter and spring, it follows that a small isotope fractionation effect on molecular dissolved oxygen can be expected during stagnation while a high isotope fractionation can be expected during winter and spring. The ^{18}O content of the sulfate dissolved in volcanic and tectonic lakes varies according to this hypothesis. The fact that similar ^{18}O contents of the dissolved sulfate are not found in the same period of different years is probably related to similarities or differences in the climatic conditions. The bio-physical behaviour of the Corbara Dam Lake is different from that of other lakes. However, because of the continuous feeding by the Tiber River, variations of the sulfate concentration and its oxygen isotopic composition can be caused by the contribution of polluted water. (auth)

5280 EFFECT OF SURFACE HYDROGEN ON THE ISOTOPIC EXCHANGE AND HYDROGENATION OF SIX-MEMBERED CYCLIC HYDROCARBONS. Nekrasov, N. V.; Gudkov, B. S.; Kiperman, S. L. (Inst. of Organic Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 208: No. 5, 1150-1153(11 Feb 1973). (In Russian).

Hydrogen–deuterium exchange in cyclohexane was studied in a quasi-static circulating system at 10 to 140 mm Hg and 0 to 50°C on a Ni catalyst supported in silica gel. The products of the exchange were measured with a mass spectrometer. The hydrogen–deuterium reaction with benzene gave somewhat different results; even at 0°C isotopic exchange was accompanied by the hydrogenation of benzene. (KSW)

5281 FRACTIONATION OF CARBON ISOTOPES BY PHOTOTROPIC BACTERIA ECTOTHIORODOSPIRA SHAPOSHNIKOVII. Gogotova, G. I.; Galimov, E. M.; Ivanov, M. V. (Inst. of Biochemistry and Physiology of Microorganism, Pushchino, USSR). Dokl. Akad. Nauk SSSR; 208: No. 5, 1224-1225(11 Feb 1973). (In Russian).

The carbon isotope effect resulting from the metabolic processes of the phototropic gray bacterium Ectothiorodospira shaposhnikovii (Ect. shap.) was studied. A culture of Ect. shap. in a bicarbonate–thiosulfate medium of pH 8.2 grown in the light under anaerobic conditions was sampled for mass spectrometric study of the isotopic composition of the biomass carbon. The coefficient of fractionation of ^{13}C was 1.1 to 1.5%, the residual bicarbonate becoming enriched in ^{13}C as a result of the preferential assimilation by Ect. shap. of the light C isotope. (KSW)

5282 ISOTOPIC SEPARATION PROCESS. Herold, A. (to Agence Nationale de Valorisation de la Recherche). French Patent 2,120,345. 18 Aug 1972. Filed date 30 Dec 1970. 8p. (In French).

In this hydrogen isotope separation process, reactions involving the insertion of hydrogen in a carboniferous material were effected by contact with this material. Two methods of operation are possible: the collection of the hydrogen having been in contact with the carboniferous material (the gas being deuterium enriched); dissociation by heating the carboniferous material in which the hydrogen has been inserted (the vapor produced by dissociation being deuterium enriched). The carboniferous material may be in the form of graphite a nongraphited carbon, boron doped carbon, or carbon containing an alkali metal (KC_8 or KC_{24}). The isotope effect is more important with alkali metal carboniferous materials. It is also possible to insert substances such as halogens, certain halides (in particular UF_6) and certain oxides into carboniferous materials. (FR)

5283 HYDROGEN DIFFUSION CELL AND A METHOD TO OPERATE A HYDROGEN DIFFUSION CELL. Alefeld, G.; Voelkl, J.; Klatt, K. H.; Wollenweber, G. (to Kernforschungsanlage). German Patent 2,133,043. 21 Jan 1973. 5p. (In German).

The patent claim refers to a hydrogen diffusion cell with partitioned walls made from vanadium, niobium, tantalum, or alloys of these metals (e.g., with Mo, Re) which are arranged in specified distances and which are permeable for the hydrogen or the hydrogen isotope to be separated, but impermeable or only slightly permeable for impurities or the hydrogen isotopes which have to be retained. (GE)

Feed Materials Processing

5284 METHOD OF EXTRACTING URANIUM FROM SEAWATER. Riedel, H. J. (to Kernforschungsanlage Juelich GmbH). U. S. Patent 3,721,533. 20 Mar 1973. Priority date 6 Jun 1969, Federal Republic of Germany (F. R. Germany). 4p.

A method is presented for extracting uranium in the form of tricarbonate complexes of UO_2^{++} from seawater or other liquids rich in metal ions. The seawater is acidified to a pH of approximately 5 (e.g. with hydrochloric acid or HNO_3), and then is treated with ultramarine blue in an ion-exchange relationship until equilibrium is reached in the distribution of uranium between the ultramarine blue and the seawater. Elution of the uranium is carried out with an alkali carbonate solution. (auth)

5285 OPENING RARE EARTH ORES WITH PERFLUOROALKANESULFONIC ACID. Thom, K. F. (to Minnesota Mining and Mfg. Co.). U. S. Patent 3,725,296. 3 Apr 1973. Filed date 20 Feb 1970. 6p.

Rare earth metals and related ions such as Th and U are extracted from ores by treatment with aqueous solutions of perfluoroalkanesulfonic acids. Trivalent metals are extracted preferentially; tetravalent metals tend not to dissolve as readily. (auth)

Radiation Chemistry

5286 (AD-753917) SPECTRAL IDENTIFICATION OF COMPOUNDS FORMED BY NUCLEAR RADIATION IN AIR FOR REMOTE FALLOUT SURVEY. Harmatz, M. (Army Electronics Command, Fort Monmouth, N. J.). Nov 1972. 22p. (ECOM-4053). NTIS.

Measurements of the nitrogen compound formation produced by ionizing irradiation on air at 300°K and 760 mm Hg are reported. Infrared spectrophotometry measurements of dry air exposed to 0.230 curie ^{210}Po showed that nitrous oxide and nitrogen pentoxide were the initial products formed. There were indications that the decomposition of the nitrogen pentoxide following 25 hours of exposure enhanced the growth of nitrogen dioxide. Throughout the irradiation period, nitrous oxide was a major and the most stable constituent peak. Infrared spectra of air exposed to lower activity values 0.115 to 0.050 curie also exhibited nitrous oxide as a dominant constituent. The results obtained from irradiating air with the three alpha particle sources indicated that the formation of nitrous oxide and nitrogen dioxide was dose rate dependent. (NTIS)

5287 (CEA-R-4451) APPLICATION OF PHYSICOCHEMICAL METHODS OF ANALYSIS TO TRILAURYLAMINE RADIATION STABILITY STUDY. Saey, J. C.; Germain, M.; Bathellier, A. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). May 1973. 68p. (In French). Dep NTIS (U. S. Sales Only) $5.50.

The chemical effects of γ radiation on trilaurylamine are investigated. The identity of a dozen degradation products is established with more or less certainty; they can be classified into two series: light compounds with about 12 carbon atoms by molecule and intermediate compounds with about 24 carbon atoms by molecule. After qualitative analysis, the concentration evolutions with irradiation dose are studied for trilaurylamine and radiolytic products up to 300 Wh. 1^{-1}. Gas-liquid chromatography is largely used as qualitative and quantitative analytical method and for fine separations. Coarse separations are obtained using thin layer chromatography and vacuum distillation. The separated compounds are identified by mass spectrometry and infrared absorption studies. (auth)

5288 (ORO-4059-3) RADIATION CHEMISTRY OF HIGH POLYMERS. Progress Report No. 3, 15 April 1972–1 May 1973. Dole, M.; Welch, R. A. (Baylor Univ., Waco, Tex.). 15 May 1973. Contract AT(40-1)-4059. 9p. Dep. NTIS $3.00.

Progress is reported on: (a) an electron spin resonance study of the effects of γ radiation on polyethylene in which a kinetic study was made of the alkyl radical, $-CH_2\dot{C}HCH_2-$, and allyl radical $-CH_2\dot{C}HCH{=}CH-$, decay rates and (b) a study of the solubility of hydrogen in irradiated polyethylene. (DHM)

5289 CHANGE OF MECHANICAL PROPERTIES OF STYRENE PLASTICS BY HIGH-ENERGY RADIATION. Knappe, W.; Zyball, A. (Deutsches Kunststoff Inst., Darmstadt, Ger.). Kunststoffe; 62: No. 9, 580-587(1972). (In German).

The effects of 1 MeV electron beams on the mechanical properties of standard polystyrene, styrene–acrylonitrile, and acrylonitrile–butadiene–styrene copolymers were investigated with doses up to 100 Mrad. Despite the cross-linking in polysterene, which was proven by gel-sol measurements, no radical improvement could be found in the investigated mechanical properties. On the other hand, there was a considerable improvement caused by irradiation in the mechanical properties of the styrene–butadiene copolymer, especially in its creep-stress behavior. In the case of styrene–acrylonitrile and acrylonitrile–butadiene–styrene copolymers, it is thought that chain breaking occurs when irradiating the acrylonitrile sequence, and therefore the mechanical properties cannot improve to the extent of the styrene, in particular styrene–butadiene copolymers. (GF)

5290 GLASSY-STATE AND GAMMA-INDUCED POLYMERIZATION OF 2-AMINO-4-N-METHYLANILINO-6-ISOPROPENYL-S-TRIAZINE. Yuki, Y. (Nagoya Inst. of Tech., Japan); Nagano, M.; Taika, T.; Kawase, K. Kobunshi Kagaku; 29: No. 333, 939-942(Dec 1972). (In Japanese).

It was found that 2-amino-4, N-methylanilino-6-isopropenyl-s-triazine (I) formed a glassy state by rapid cooling after melting. The glass transition temperature determined by DSC method was 16°C. The γ-ray induced bulk polymerization of I in glassy-state and supercooled liquid state was carried out at the dose rate of 1×10^6 rad/hr at −78°, 0°, 25° and 38°C. The apparent activation energy was 0.3 kcal/mol at the lower temperature and 9 kcal/mol at a temperature higher than the glass transition temperature, 16°C. (auth)

5291 GRAFT-COPOLYMERIZATION OF METHYL METHACRYLATE-STYRENE MONOMERS ON STARCH PREIRRADIATED USING AN ELECTRON ACCELERATOR. Otsuka, N. (Science Univ. of Tokyo); Handa, T.; Miyata, K.; Ayukawa, Y. Kobunshi Kagaku; 29: No. 332, 930-935(Dec 1972). (In Japanese).

5292 EFFECT OF POLYMETHYL ACRYLATE ON THE RATE OF BULK POLYMERIZATION OF METHYL ACRYLATE. Mitsui, H. (Japan Atomic Energy Research Inst., Takasaki); Tsuneta, K.; Kagiya, T. Kobunshi Kagaku; 29: No. 331, 806-810(Nov 1972). (In Japanese).

The effects of poly(methyl acrylate) (PMA) on the rate of bulk polymerization of methyl acrylate were investigated in connection with the viscosity of the reaction system. The polymerizations initiated by α, α′-azobisisobutyronitrile and γ-rays were carried out at 40 and 30°C, respectively. In all the systems investigated, the polymer yield in the initial stage of the polymerization was proportional to the second power of reaction time, and the rate of the increment increased exponentially with increasing PMA content. The viscosity of the system also increased exponentially with the PMA content. The conclusion is that, in the initial stage of the polymerization, the growing chain radicals are hardly terminated. The increase in the apparent polymerization rate brought about by the increase in the viscosity of the system by adding PMA was ascribed to the retardation of bimolecular deactivation reaction of primary radicals in increase in the initiation efficiency. (auth)

5293 GRAFT-COPOLYMERIZATION OF METHYL METHACRYLATE-STYRENE MONOMERS ON STARCH PREIRRADIATED USING AN ELECTRON ACCELERATOR. Otsuka, N. (Science Univ. of Tokyo); Handa, T.; Miyata, K.; Ayukawa, Y. Kobunshi Kagaku; 29: No. 332, 935-939(Dec 1972). (In Japanese).

Graft-copolymerization of binary monomer system (MMA–styrene–methanol) onto preirradiated starch was pursued particularly with respect to the problem where graft- or homo-copolymerization had been induced. Gel-effect to accelerate the reaction-rate was recognized with respect to homo-copolymerization, while with respect to graft-copolymerization linear conversion vs. time was recognized which denied the acceleration induced by gel-effect. The intrinsic viscosity suggested that molecular weight of homo-copolymers is higher than that of graft-copolymers. Electron-microscopic observation suggests that homo-copolymerization was primarily induced in solution and that the homo-copolymer formed was adhered onto the surface of starch granules and grown. (auth)

5294 CHANGE IN THE DIELECTRIC PARAMETERS OF SOME POLYMERIC MATERIALS UNDER PULSED GAMMA-NEUTRON IRRADIATION. Zubov, V. V.; Zysin, Yu. A.; Tuturov, Yu. F.; Khokhryakov, V. F. Vysokomol. Soedin., Ser. A; 14: No. 12, 2634-2639(Dec 1972). (In Russian).

Experimental results are presented on the action of pulsed γ-neutron radiation on the dielectric permeability and the loss factor of polystyrene, polyethylene, oriented polytetrafluoroethylene, and poly (methyl methacrylate). The reversible changes in these parameters were studied for the case of irradiation with pulses of the half-width 3 msec. The maximum absorbed dose per pulse has not exceeded 10^6 rad. The dependences of the relative changes in dielectric permeability $\Delta\epsilon/\epsilon_0$ on the absorbed dose rate at various temperatures were obtained. The greatest deviation of $\Delta\epsilon/\epsilon_0$ (40%) was observed for polystyrene. The change in the loss factor for these materials under irradiation can be represented by a double-peaked curve. Under the assumption that the polarization effects observed are caused by the capture of charge pairs by traps, a model is considered on the basis of which relations were obtained for the dependences of the relative changes in dielectric permeability and the loss factor on the absorbed dose rate. The effect of the traps newly-formed under the action of radiation on the nature of the dependences of the parameters studied was demonstrated, as exmplified by polytetrafluoroethylene. (auth)

5295 REACTION OF EXCITED OXYGEN ATOMS WITH NITROUS OXIDE. Rate Constants for Reaction of Ozone With Nitric Oxide and With Nitrogen Dioxide. Ghormley, J. A.; Ellsworth, R. L.; Hochanadel, C. J. (Oak Ridge National Lab., TN). J. Phys. Chem.; 77: No. 11, 1341-1345(24 May 1973).

The ratio of rate constants for reaction of $O(^1D)$ with O_2 and with N_2O was found to be 0.31 ± 0.01, and assuming the absolute value for reaction with O_2 to be 3.6×10^{10} M^{-1} sec^{-1}, this gives 1.20×10^{11} M^{-1} sec^{-1} for reaction of $O(^1D)$ with N_2O. This reaction proceeds predominantly by two paths giving either (a) $N_2 + O_2$ or (b) 2NO. The ratio a/b was found to be 0.70 ± 0.02. The rate constant for reaction of O_3 with NO was $8.5 \pm 0.1 \times 10^6$ M^{-1} sec^{-1} at 298°K, and for reaction of O_3 with NO_2 the rate constant was $4.7 \pm 0.3 \times 10^4$ M^{-1} sec^{-1} at 298°K. The $O(^1D)$ were produced by flash photolysis of O_3 at low concentration in an atmosphere of $O_2 + N_2O$, and the rates of reaction of O_3 with NO and with NO_2, both produced in situ, were measured by means of kinetic spectrophotometry. (auth)

5296 SEMIEMPIRICAL UNRESTRICTED HARTREE–FOCK TREATMENT FOR TRAPPED ELECTRONS IN WATER, AMMONIA, AND HYDROGEN FLUORIDE. Ishimaru, S.; Kato, H.; Yamabe, T.; Fukui, K. (Kyoto Univ.). J. Phys. Chem.; 77: No. 11, 1450-1457 (24 May 1973).

The electronic states of solvated electrons in water, ammonia, and hydrogen fluoride and the related properties of solvent molecules are investigated. The cavity formed by four or six solvent molecules is then considered and, in each case, two models showing the orientation of a solvent molecule are introduced. In calculation, the semiempirical unrestricted Hartree–Fock treatment based on the INDO approximation is used and three methods for the selection of the basis set are examined. Consequently, with two of the methods which use not only valence AO's of solvent molecules but also hydrogen-like AO's located at the cavity center, the solvation energies and the excitation energies in water and ammonia and the photoelectric threshold in ammonia can be appropriately estimated and, noticeably, the absolute value of the proton spin density of water deduced from the esr data and the negative proton spin density of ammonia found in the nmr experiment are also obtained. From the aspect of spin density, the cavity will probably be in favor of the configuration in which only one of the hydrogen atoms of a solvent molecule points toward the cavity center. Calculated dipole moments of solvent molecules describe the polarization mechanism of the molecules by a trapped electron, being consistent with the polaron theory. Finally, the electron distributions of the hydrated electron and water molecules and the potential formed by water molecules are drawn and the results inherent in the system of assembled molecules are found, justifying the conventional cavity model. (auth)

5297 SUBSTITUENT EFFECTS ON ELECTRON SPIN RESONANCE PARAMETERS OF BENZYL RADICALS. Neta, P.; Schuler, R. H. (Carnegie–Mellon Univ., Pittsburgh). J. Phys. Chem.; 77: No. 11, 1368-1370(24 May 1973).

The ESR spectra of benzyl radicals substituted on the ring by CO_2^-, O^-, SO_3^-, CH_3O, CH_3, CH_3CO, CN, F, or Cl were observed during the radiolysis of aqueous solutions of the appropriate derivatives of toluene at pH 13.7. All of these radicals show ESR parameters very similar to those of benzyl radical. The extremes of the values for the CH_2 hyperfine constants are 14.91 and 16.43 G for the para O^- and F derivatives (16.34 G for benzyl) with most values, however, being in excess of 15.64 G. Effects of substitution on the hyperfine constants of the ring protons are extremely small. The smallness of the effects of substitution on the hyperfine constants shows that these various groups cause only a very limited perturbation of the electron spin distribution in the aromatic system. While the accuracy of the measurements is considerably greater than the small differences noted, it was not possible to derive any significant correlation with available substituent constants nor with theoretical calculations of the effects of substitution on spin distribution. (auth)

5298 PICOSECOND PULSE RADIOLYSIS. IV. Yield of the Solvated Electron at 30 Picoseconds. Wolff, R. K.; Bronskill, M. J.; Aldrich, J. E.; Hunt, J. W. (Univ. of Toronto). J. Phys. Chem.; 77: No. 11, 1350-1355(24 May 1973).

The "spur" diffusion model has long been the basis for the interpretation of the radiation chemistry of aqueous solutions. Two aspects of this model were studied using picosecond pulse radiolysis: $G(e_{aq}^-)$ at 30 psec, and the rate of decay of e_{aq}^- from 30 to 350 psec in the absence of scavengers. Two independent methods, one absolute and one relative to $G(e_{aq}^-)$ at 0.1 μsec, have established $G(e_{aq}^-) = 4.0 \pm 0.2$ at 30 psec. In pure water the decay of e_{aq}^- is less than 5% between 30 and 350 psec. These results disagree to the details of the theoretical predictions of the spur diffusion model. Additional experiments have determined $G(e_{sol}^-)$ at 30 psec in simple alcohols to be much lower than $G(e_{aq}^-)$ at 30 psec. It appears likely that an accurate model of the early events in the radiolysis of polar solvents must take into account the fate of the initial ion pair, i.e., H_2O^+ and e^-, in water. (auth)

5299 LIQUID CHROMATOGRAPHIC STUDY OF THE RADIOLYSIS OF AQUEOUS SOLUTIONS OF P-BROMOPHENOL. Bhatia, K.; Schuler, R. H. (Carnegie–Mellon Univ., Pittsburgh). J. Phys. Chem.; 77: No. 11, 1356-1364(24 May 1973).

The potentialities of using liquid chromatographic methods to examine radiation chemical effects in aqueous systems were explored using the radiolysis of p-bromophenol as a test system. It is shown that one can readily follow both the consumption of the starting material and the formation of products with sufficient accuracy that detailed measurements of the dependence of the reaction on various kinetic parameters are possible. Hydrated electrons are found to react quantitatively with p-bromophenol to produce p-hydroxyphenyl radicals. In the absence of a scavenger for these radicals they add to the parent molecule to produce 2-bromo-5,4′-dihydroxybiphenyl and 5-bromo-2,4′-dihydroxybiphenyl with the initial yields at millimolar solute concentrations being estimated as 1.3 and 1.0, respectively. A very pronounced dose dependence in the formation of these products is, however, observed as a result of very rapid tertiary reactions of the p-hydroxyphenyl radical which result in the production of terphenyls. Addition of a suitable source of hydrogen to the system results in the conversion of p-hydroxyphenyl radical to phenol. The yield of phenol at a p-bromophenol concentration of 5×10^{-4} M and high concentrations of isopropyl alcohol is 2.8. Measurements of the dependence of the phenol yield on the concentration of added alcohol indicate that abstraction of H from the alcohol is 2.4 times slower than the addition to p-bromophenol. By comparison with the known rate for the addition reaction a rate constant of 3×10^{7} M^{-1} sec^{-1} for the abstraction process is obtained. The experiments described were carried out on solutions containing solutes in the concentration range 10^{-4} to 10^{-2} M and products were measured in the region of 10^{-8} to 10^{-4} M. In appropriate systems measurements can be carried out on components present at concentrations as low as 10^{-8} M. The availability of rapid ultrasensitive analytical methods of the type used here obviously makes possible many types of studies which heretofore could be carried out only with difficulty or not at all. (auth)

5300 RADIOLUMINESCENCE OF XANTHENE, THIOXANTHENE, AND SELENOXANTHENE FOLLOWING PULSE IRRADIATION. Badiello, R. (Consiglio Nazionale delle Ricerche, Bologna); Fielden, E. M.; Lillicrap, S. C. Int. J. Radiat. Phys. Chem.; 5: No. 2, 173-181(Mar 1973).

The technique of pulse radiolysis was applied to study luminescence phenomena of the radioprotective agent selenoxanthene in crystalline form. Comparative data were also obtained for the analogous compounds thioxanthene and xanthene. The spectral distributions of the radiation-induced luminescence were studied as a function of time and of temperature giving information about the disposition and the fate of excitation energy produced by ionizing radiation. Selenoxanthene exhibits only phosphorescent emission, whereas the xanthene emission is mainly fluorescence. The behavior of thioxanthene lies between these two. The results are interpreted in terms of a "heavy-atom" effect on internal quenching and intersystem crossing. The possible significance of such effects in radiobiological protection by selenoxanthene is discussed. (auth)

5301 RADIATION CHEMICAL DEHYDROGENATION OF ALKENES. Cserep, G.; Foldiak, G. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). Int. J. Radiat. Phys. Chem.; 5: No. 2, 235-237(Mar 1973).

One of the most fundamental processes taking place when alkenes are irradiated at room temperature is dehydrogenation. The literature, however, is not unanimous in its view of how this hydrogen is produced, i. e. what type of C–H bonds (vinylic, allylic, or others) take part in the reactions. $G(H_2)$ for a variety of alkenes was determined and some empirical relationships connecting these are given. (auth)

5302 CHANGE IN THE CRYSTALLINITY OF SOME FLUORINE-CONTAINING COPOLYMERS UNDER γ RADIATION. Berlyant, S. M.; Gavlovskii, A. A.; Karpov, V. L. (Scientific Research Physical-Chemical Inst., Moscow). Vysokomol. Soedin., Ser. B; 15: No. 2, 120-124(Feb 1973). (In Russian).

The amorphism of copolymers of tetrafluoroethylene with vinylidene fluoride and tetrafluoroethylene with ethylene proceeded under a dose of 200MR of γ-radiation, as shown by differential thermal analysis. Indications from x-ray diffraction, however, were that the first polymer underwent initial amorphism at a dose of ~500 MR, and for the second, ~1000 MR. (KSW)

5303 SIGNAL-COMPILING DIFFERENTIAL PREAMPLIFIER FOR PULSE RADIOLYSIS EXPERIMENTS. Brown, B. J. (New South Wales Univ., Kensington, Australia); Bell, J.; Barker, N. T.; Sangster, D. F. J. Phys., E (London); 6: No. 5, 428-429(May 1973).

A signal-compiling differential preamplifier for use in pulse-radiolysis experiments is described. The unit permits the measurement from one signal of the magnitude of the irradiating pulse and the concentration and reaction kinetic parameters of the transient species produced. (auth)

5304 SF_6 ADDED TO IRRADIATED GASEOUS ETHYLENE ACTS NOT ONLY AS AN ELECTRON SCAVENGER. Niedzielski, J.; Gawlowski, J. (Univ., Warsaw). Int. J. Radiat. Phys. Chem.; 5: No. 2, 239-241(Mar 1973).

The reduction in the yields of C_4 unsaturated hydrocarbons from $C_2H_4-NH_3$ mixtures in the presence of SF_6 is due to secondary processes involving a radical derived from SF_6. (auth)

5305 COLOUR CENTRE LUMINESCENCE IN $KMgF_3$: Mn CRYSTALS. Sibley, W. A.; Yun, S. I.; Vehse, W. E. (Oklahoma State Univ., Stillwater). J. Phys., C (London); 6: No. 6, 1105-1115(28 Mar 1973).

Optical absorption and emission studies of $KMgF_3$ crystals containing various amounts of Mn^{2+} (0.04 to 91.2 at.%) were made. Recently it was determined that when crystals containing about 1.4 at.% Mn are irradiated with high energy electrons the absorption spectrum is dominated by a set of five bands originating from a single defect. It was proposed that these bands arise from a defect involving an F centre trapped between adjacent Mn impurity ions. These observed optical absorption bands are assigned to Mn-pair 3d electron transitions perturbed by the presence of the F centre. Optical excitation at 300°K into any of these five absorption bands (230, 248, 280, 410, and 565 nm) results in an emission band at 630 nm, whereas similar excitation at 77°K or below gives a luminescence at 677 nm which has a much longer lifetime than the 630 nm band. The luminescence is discussed in terms of Mn^{2+} transitions and the thermal population of energy levels. (auth)

5306 RADIATION CHEMISTRY OF AQUEOUS SOLUTIONS OF CUPRIC ETHYLENEDIAMINE TETRA-ACETATE. Bhattacharyya, S. N.; Kundu, K. P. (Saha Inst. of Nuclear Physics, Calcutta). Int. J. Radiat. Phys. Chem.; 5: No. 2, 183-195(Mar 1973).

Neutral and alkaline aqueous solutions of cupric ethylenediaminetetraacetate (C) were irradiated with x-rays both in the presence and in the absence of dissolved oxygen. Radiolytic yields of decomposition of C were determined. The formation of hydrogen peroxide and formaldehyde in the system was also followed. It has been observed that the radiolysis is initiated by attack both at the ligand and at the central metal ion of the metal chelate by the free radicals derived from water. A radiolytic mechanism is proposed and discussed in the light of the observed results. From competition kinetic studies with CH_3OH in neutral solution the rate constant k(OH + C) was found to be 2.04×10^{9} dm^3 mol^{-1} s^{-1}. (auth)

5307 GAMMA RADIOLYSIS OF SOLUTIONS OF BENZYLCHLORIDE AND CHLOROBENZENE IN CYCLOHEXANE. Solute Effect in Hydrogen Yield, and the Mechanism of Hydrogen Chloride Formation Via Electron Capture. Horowitz, A.; Rajbenbach, L. A. (Israel Atomic Energy Commission, Yavne). Int. J. Radiat. Phys. Chem.; 5: No. 2, 163-172(Mar 1973).

The radiolytic yields of hydrogen and hydrogen chloride in cyclohexane solutions of chlorobenzene and benzylchloride were determined. Electron capture by the solutes seems to lead to the major part of the hydrogen chloride yield. On the basis of a comparison of the hydrogen chloride yields from the two solutes, it is suggested that the potential energy curves for electron attachment to chlorobenzene in the liquid phase are significantly different from those in the gas phase. Possible mechanisms, other than charge scavenging by solutes, are considered to account for part of the hydrogen chloride yield and for the low limiting value of hydrogen yields. (auth)

5308 BEHAVIOR OF THE VIONIT-TYPE ION EXCHANGE RESINS ON IRRADIATION. I. Anion Exchange Resins. Oltenasu, M.; Sava, L. Rev. Chim. (Bucharest); 23: No. 12, 246-254(Dec 1972). (In Rumanian).

The effects of radiation on ion exchange resins manufactured by the Victoria Chemical Works and used to purify radioactive waste effluents from the reactor, were investigated. Samples of the strongly basic Vionit AT-1 and the slightly basic Vionit AS-1 resins were exposed to integrated doses of 10^6, 10^7, 10^8, 5×10^8, and 10^9 rad from a 10,000 Cie ^{60}Co source. The results revealed that the samples tested are competitive with similar products from abroad. The AT-1 resin exhibited an excellent stability up to 10^7 rad. The total exchanging capacity of the resin was not affected by the ionic form. At doses higher than 10^7 rad, the salt-type resins (Cl^-, SO_4^{2-}) were found to be more resistant; beyond 10^8 rad, the grains lost their mechanical strength, became sticky and could not be used anymore. The radiation resistance increased with increasing degree of reticulation of the support. The AS-1 resin exhibited a very good resistance at doses higher than 10^7 rad, but this resistance decreased with increasing reticulation. (TTT)

5309 PREPARATION OF RADIOCARBON COMPOUNDS BY PYROLYSIS OF POLYMERS FORMED IN REACTOR-IRRADIATED PYRIDINE. Barakat, M. F.; Adbel-Ghany, M. (Atomic Energy Establishment, Inshas, Egypt). 15: No. 1, 24-26(1973).

The polymer found in reactor-irradiated pyridine, containing the greater fraction of the generated carbon-14 recoils, was thermally treated, and the degradation products were identified by radio-gas chromatography. Pyrolysis was carried out using a flow reactor-type pyrolyser under different experimental conditions. In almost all cases, the polymer samples were completely transformed into a group of more simple volatile labelled products. Pyridine-^{14}C was obtained in remarkable yields. Some labeled methyl and ethyl pyridine derivatives together with benzene were also obtained but in relatively lower yields. The different factors affecting the possibility of using a pyrolysis step, following reactor irradiation of organic nitrogen compounds, as a means for preparing high specific activity radiocarbon compounds are discussed. (GF)

5310 MOLECULAR HYDROGEN FORMATION IN THE GAMMA RADIOLYSIS OF WATER AND AQUEOUS SOLUTIONS. Faraggi, M. (Israel Atomic Energy Commission, Beersheba). Int. J. Radiat. Phys. Chem.; 5: No. 2, 197-206(Mar 1973).

The radiolytic hydrogen yield G_{H_2} from deaerated aqueous solutions of various di- and tri-positive metal ions was found to be in many cases independent of the solute concentration (up to 0.1 mole dm^{-3}). However, in Cd^{2+}, Cu^{2+}, Cr^{2+}, Pb^{2+}, and acidic Hg^{2+} solutions, G_{H_2} decreased with increasing solute concentration. The efficiency of these ions in reducing the hydrogen yield is in the order: $Hg^{2+} > Pb^{2+} > Cr^{2+} \approx Cu^{2+} > Cd^{2+}$. The fact that all these metal ions are good scavengers for the reducing species produced in the radiolysis of water (e^-_{aq} and H atoms) leads to the conclusion that they are not the main precursors of H_2. Homogeneous kinetics was used to express the dependence of G_{H_2} on solute concentration. The rate-determining step is considered to be the pseudo first-order disappearance of the H_2 precursor. It could be either the hydride ion produced by the reaction of subexcitation electrons with water as proposed by Platzman, the dry electrons suggested by Hamill, or the H_3O radicals of Sworski and Smaller. The chemical reactivity of the above ions towards the H_2 precursor is shown to be parallel to the rate of ligand substitution in the aquated metal ions as measured by Eigen. It is also shown that part (≈20 percent) of the H_2 may be produced by a radical–radical reaction mechanism. (auth)

5311 HYDRATED ELECTRON REACTIONS WITH NUCLEIC ACID BASES IN MICELLAR SYSTEMS. Greenstock, C. L.; Dunlop, I. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Int. J. Radiat. Phys. Chem.; 5: No. 2, 231-233(Mar 1973).

Rate constants for diffusion controlled e^-_{aq} reactions with nucleic acid bases and for electron transfer from their electron-adducts to electron-affinic acceptors are essentially unchanged in simple micellar systems. The reactivities of e^-_{aq} were determined by pulse radiolysis. (auth)

5312 RADIOLYSIS OF SOLID AMMONIUM NITRATE. Szentirmay, Z.; Patko, J. (Kossuth Lajos Tudomanyegyetem, Debrecen, Hungary). Z. Phys. Chem. (Frankfurt); 83: No. 1-4, 13-24(1973).

The radiolysis of crystalline NH_4NO_3 was studied with ^{60}Co gamma rays and x rays of 58 keV effective energy. The gamma irradiations were carried out at room temperature with doses of 0 to 30 Mrads, the irradiations with x-rays at doses of 0 to 30 krads at different temperatures. The radiolytic yields of nitrite ions, nitrous oxide, nitric acid, and water were measured as a function of the absorbed dose. Up to absorbed doses of 2 Mrads, the radiolytic decomposition of ammonium nitrate was found to be very similar to that of other nitrates; for doses above 2 Mrads it is comparable to that of thermal decomposition. (GF)

5313 RADIATION-INDUCED OXIDATION OF AQUEOUS SOLUTIONS OF 2,5-DICHLOROHYDROQUINONE. Fellows, T. J.; Hughes, G. (Univ. of Liverpool). Int. J. Radiat. Phys. Chem.; 5: No. 2, 207-212(Mar 1973).

The γ-radioinduced oxidation of 2,5-dichlorohydroquinone in aqueous solution was investigated. The products are hydrogen peroxide and 2,5-dichloro-p-benzoquinone. The yields are pH dependent, and G(2,5-dichloro-p-benzoquinone) decreases to almost zero at pH > 2. The reaction mechanism was found to be much more complex than the simple scheme originally proposed. (auth)

5314 CHEMICAL CHANGES FOLLOWING γ-IRRADIATION OF BENZYLPENICILLIN IN AQUEOUS SOLUTION. Phillips, G. O.; Power, D. M.; Robinson, C. (Univ. of Salford, Eng.). J. Chem. Soc., Perkin Trans., II; No. 5, 575-582(1973).

The effects of γ irradiation on aqueous solutions of sodium benzylpenicillin were investigated. Pulse radiolysis indicates that both hydrated electrons and hydroxyl radicals are responsible for the degradation between 10^{-4} and 10^{-2}M solute concentrations. Reaction of hydroxyl radicals with the benzene ring of the penicillin side-chain leads to the formation of o-, m-, and p-hydroxylbenzylpenicillins. Hydroxyl radicals also induce cleavage of the β-lactam ring, yielding benzylpenilloic and benzylpenicilloic acid. Reaction of hydrated electrons with penicillins generally lead to molecular rearrangements yielding products such as benzylpenillic acid. (auth)

5315 DECOMPOSITION OF POLYCHLORINATED BIPHENYLS (PCB) BY USING RADIOISOTOPES. Sawai, T. (Tokyo Metropolitan Isotope Research Center). Genshiryoku Kogyo; 18: No. 12, 43-47(Dec 1972). (In Japanese).

PCB (polychlorinated biphenyl) has been used widely for making electrical insulating oil, pressure-sensitive paper, printing ink, etc. This is now presenting a large problem in environmental pollution, for it is extremely difficult to decompose the PCB, without producing secondary pollutants. Methods of decomposing the PCB, primarily the procedure using ionizing radiation, are reviewed. It is important to raise the decomposition yield, by finding conditions under which the decomposition is effected by chain reaction due to irradiation. Dechlorination, i.e. the PCB decomposition, increases and concentration of alkali used decreases with increasing radiation dosage. PCB, generally, can be decomposed with high efficiency by irradiating alkaline 2-propanol solution of the PCB saturated with nitrogen. Methods other than by radiation, those utilizing combustion and light ray, are briefly explained. (Japan)

5316 IRRADIATED BETAINE HYDROCHLORIDE: THE FREE RADICAL, $N(CH_3)_3^+$. Whelan, D. J. (Defence Standards Labs., Ascot Vale, Australia). Aust. J. Chem.; 26: No. 3, 681-685(Mar 1973).

The ESR parameters for the free radical, $N(CH_3)_3^+$, trapped in monoclinic single crystals of γ-irradiated betaine hydrochloride, were investigated. The hyperfine splittings have isotropic values, $A^N_{iso} = 2.26$ mT and $A^{\beta\text{-}H}_{iso} = 2.79$ mT, and the isotropic value of the g-tensor is 2.0039. A critical analysis of previously reported data on this free radical is presented. (auth)

5317 PULSE RADIOLYSIS OF 1,4-DICYANOBENZENE IN AQUEOUS SOLUTIONS IN THE PRESENCE AND ABSENCE OF THALLIUM(I) IONS. Robinson, E. A.; Schulte-Frohlinde, D. (Max-Planck-Institut fuer Kohlenforschung, Muelheim an der Ruhr, Ger.). J. Chem. Soc., Faraday Trans., I; 69: No. 4, 707-718(1973).

The rate constants for the reaction of 1,4-dicyanobenzene with the hydrated electron ($k_2 = 2.4 \times 10^{10}$ M^{-1} s^{-1}), the hydroxyl radical ($k_2 = 7.2 \times 10^8$ M^{-1} s^{-1}) and the hydrogen atom ($k_2 = 3.5 \times 10^8$ M^{-1} s^{-1}) were measured together with the spectra and extinction coefficients of the resulting adducts. By addition of methanol and of oxygen respectively it was possible to observe separately the adduct formed by the hydrogen atom and that formed by the hydroxyl radical. The radical anion of 1,4-dicyanobenzene, formed by reaction with the hydrated electron in neutral, de-aerated solution, can also be produced in acid solution if thallium(I) sulphate is present. Evidence is presented to show that the reduced form of the thallium(I) ions, Tl^0 or Tl_2^+, which is formed in reaction with the H atom in acid solution, is capable of reducing 1,4-dicyanobenzene to give the anion at pH values as low as 0.01 ($k(Tl_2^+ + DCNB) = 2.7 \times 10^9$ M^{-1} s^{-1}). Similar results were obtained using 1,4-dinitrobenzene and it is suggested that addition of Tl^+ may find further applications as a method of producing radical anions in solution at low pH by pulse radiolysis. (auth)

5318 KETYL RADICALS IN AQUEOUS SOLUTION PULSE RADIOLYSIS STUDY. Adams, G. E.; Willson, R. L. (Mount Vernon Hospital, Northwood, Eng.). J. Chem. Soc., Faraday Trans., I; 69: No. 4, 719-729(1973).

The absorption spectra, extinction coefficients, and acid dissociation constants of the ketyl radicals of benzophenone, acetophenone, and its p-fluoro-, p-chloro-, p-bromo- and p-nitro-derivatives were determined by pulse radiolysis. Rate constants for electron transfer from some simple organic radicals to the phenones were determined in alkaline solution. Studies with p-nitroacetophenone in neutral and alkaline solution show that both electron transfer and radical addition can take place, the relative proportion depending upon the structure of the radical. (auth)

5319 SEMIQUINONE FREE RADICALS AND OXYGEN. Pulse Radiolysis Study of One Electron Transfer Equilibria. Patel, K. B.; Willson, R. L. (Mount Vernon Hospital, Northwood, Eng.). J. Chem. Soc., Faraday Trans., I; 69: No. 4, 814-825(1973).

The absorption characteristics and acid dissociation constants of the semiquinone radicals of several methyl derivatives of benzoquinone and naphthoquinone were determined by pulse radiolysis. Absolute rate constants for electron transfer from the superoxide-ion O_2^- to methyl- and dimethylbenzoquinones were determined. In the case of duroquinone, evidence has been obtained for the occurrence of the equilibrium reaction: O_2^- + duroquinone $\rightleftharpoons$ O_2 + durosemiquinone with $K_c = 2.3 \pm 0.2 \times 10^{-2}$. (auth)

5320 ELECTRON TUNNELLING IN FROZEN AQUEOUS SOLUTIONS AT 77K. Kroh, J.; Stradowski, C. (Politechnika, Lodza, Poland). Int. J. Radiat. Phys. Chem.; 5: No. 2, 243-245(Mar 1973).

The decrease in concentration of stabilized electrons in frozen aqueous solutions at 77°K is described and assigned to tunnelling of scavenger molecules. (auth)

5321 INFLUENCE OF RADIATION ON THE BEHAVIOR OF IRON CHELATE. Margulova, T. Kh.; Tevlin, S. A.; Lebedev, Yu. E.; Milaev, A. I. (Moscow Power Inst.). Therm. Eng. (USSR) (Engl. Transl.); 19: No. 3, 15-16(Mar 1972).

Translated from Teploenergetika; 19: No. 3, 10-12(Mar 1972).

The effects of radiation on iron chelates were studied in order to determine their potential for use in the removal of deposits and in the formation of protective films on steels in the nuclear power industry. It was found that the processes of conversion of iron chelates due to radiation and temperature are similar. It is concluded that the removal of iron oxide deposits from reactor loops can be conducted only with small doses of radiation (up to 5 Mrad). Irradiation leads to decomposition of iron chelates, creating a protective film on steels in a shorter time and at a lower temperature than under conditions of thermal decomposition alone. (JGB)

5322 RADIATION-INDUCED COPOLYMERIZATION OF VINYL ACETATE WITH VINYLPYRIDINE. Tashmukhamedov, S. A.; Karabaev, A. Sh.; Tillaev, R. S. (Tashkent State Univ.). Uzb. Khim. Zh.; No. 5, 57-59(1972). (In Russian).

The copolymerization of vinyl acetate with vinylpyridine was brought about by 0.1 to 3.0 MR of ^{60}Co γ radiation at a dose rate of 67 R/sec in acetic acid, benzene, methanol, and CCl_4. Copolymer yields were enhanced directly in proportion to the size of the radiation dose, but did not exceed 40% even in CCl_4. The copolymer was relatively enriched in the vinylpyridine component at all ratios of the two monomers; the copolymerization constants were 0.025 for vinyl acetate and 3.90 for vinylpyridine. When the dose rate was increased from 5 to 203 R/sec, the copolymer yield was reduced. A value of the exponent n in the equation for the dependence of the copolymerization rate on dose rate, n = 0.41, confirmed the radical mechanism of copolymerization and a bimolecular mechanism of chain breakage. (tr-auth)

5323 CATALYTIC-, PHOTOCHEMICAL-, AND RADIATION-INDUCED CHLORINATION OF ACETIC ACID. Kowalski, A. (Politechnika, Lodz, Poland). Nukleonika; 18: No. 1, 11-24(1973). (In Polish).

The results of investigations on catalytic-, photochemical-, and radiation-induced chlorination of acetic acid are summarized. Chlorination was carried out on the preparative scale for all three methods and the rates of process as well as selectivities were compared. The highest rate and simultaneously high selectivity i.e., highest contribution of monochloracetic acid, was observed in the case of catalytic chlorination. New catalyst, chlorsulfonic acid, was found to be as efficient as well known but expensive Brückner's catalyst containing iodine, phosphorus and phosphorus pentachloride. No chlorination of acetic acid was found without catalyst or in the absence of uv or γ-radiation. The rate of photochemical- and radiation-induced processes was high but good selectivity was lost resulting in higher concentration of di- and trichloracetic acid. Quantum and radiation yields were determined for all i.e., mono-, and trichloracetic acid. In separate experiments reactions catalyzed by acetic anhydride or chlorsulfonic acid was carried out in the field of γ-radiation. In such a case two processes were observed. The first catalytic reaction proceeded according to a molecular mechanism whereas the second one radiation-induced seems to be a radical-chain process. Radiation chlorination of acetic acid was found to be strongly inhibited in the presence of iodine. (auth)

5324 RADIATION-INDUCED GRAFT COPOLYMERIZATION AT ROOM TEMPERATURE. Kabanov, V. Ya.; Sidorova, L. P. (Inst. of Physical Chemistry, Moscow). Vysokomol. Soedin., Ser. A; 14: No. 10, 2091-2095(Oct 1972). (In Russian).

The radiation-induced grafting of monomers polymerizable only by the ionic mechanism (α-methylstyrene, vinyl n-butyl ether and isobutylene) onto polyethylene, teflon, and poly(vinyl chloride) was carried out, the monomers and the whole system being thoroughly dried. Up to 15 to 20% grafting, practically no homopolymer is formed in spite of the process occurring in the liquid phase. The grafting percentage depends strongly on the degree of drying of monomers and the whole system. Drying was carried out under deep vacuum using specially prepared barium oxide. The radiation-chemical yield is equal to 10^2 to 10^3. (auth)

5325 INVESTIGATION OF THE RADIATION-INDUCED POLYMERIZATION MECHANISM OF SOLID FORMALDEHYDE. Kiryukhin, D. P.; Kaplan, A. M.; Barkalov, I. M.; Gol'danskii, V. I. (Inst. of Chemical Physics, Moscow). Vysokomol. Soedin., Ser. A; 14: No. 10, 2115-2119(Oct 1972). (In Russian).

The kinetics of radiation-induced polymerization of formaldehyde (FA) were studied in the temperature range 15 to 140°K by the calorimetric method. The phase analysis of FA showed the absence of any phase transitions over the whole temperature range studied. The heat of fusion of FA was determined and found equal to 1.80 ± 0.05 kcal/mole. Under isothermal conditions polymerization of solid FA occurs with high radiation yields (at 80°K $G(-M) \simeq 10^5$ and at 15°K $\simeq 10^3$), which points to a chain mechanism. At such low temperatures chain reactions were observed for the first time. Already at low conversion degrees (0.2 to 0.5%) the decrease in the polymerization rate of FA at constant temperature becomes appreciable, which is due to decrease of the growth constant of a polymer chain propagating in a solid crystal. Postpolymerization of FA was observed as well. At the temperatures 80 to 140°K the activation energy of polymerization of FA is 2 ± 0.6 kcal/mole. However, at lower temperatures the temperature dependence of the rate weakens and the polymerization reaction occurs practically without activation. It is suggested that at low temperatures in solid FA the tunnel proton transfer mechanism of chain propagation prevails. (auth)

5326 CYCLOPENTADIENYLMANGANESE TRICARBONYL COMPOUNDS AS A CATALYST FOR THE RADIATION CURING OF POLYEPOXIDES. Anderson, W. S. U. S. Patent 3,714,006. 30 Jan 1973. Filed date 15 May 1972. 10p.

The cure of polyepoxide resins with a reactive acid anhydride or polymercaptan curing agent is accelerated in the presence of electromagnetic radiation of wave length from 1 to 7,000 A., e.g. γ rays, x-rays, ultraviolet and visible light, and a catalytic amount of a cyclopentadienylmanganese tricarbonyl compound, e.g., methylcyclopentadienylmanganese tricarbonyl. The ultraviolet to visible range is preferred. (auth)

5327 OXIDATIVE RADIOLYSIS OF 3,4-BENZOPYRENE IN THE LIQUID PHASE. Uibopuu, Kh. M.; Gubergrits, M. Ya.; Rayavee, E. L. (Inst. of Chemistry, Tallin). Latv. PSR Zinat. Akad. Vestis; No. 3, 116-118(1973). (In Russian).

Samples of 3,4-benzopyrene in the solvents benzene, n-octane, and acetone were irradiated with ^{60}Co-emitted gamma radiation. The degree of decomposition by radiolysis increased with greater dilutions of the benzopyrene, and the radiolysis efficiency was determined to a considerable extent by the nature of the solvent. The kinetics of degradation of benzopyrene at an initial concentration of 2×10^{-3} mole/l was studied up to a dose of 10 MR (62.4×10^{19} eV/ml). (KSW)

5328 SPECTRA OF GASEOUS PRODUCTS LIBERATED DURING THE BOMBARDMENT OF POLYTETRAFLUOROETHYLENE FILMS BY MEDIUM ENERGY ELECTRONS. Borisova, M. E.; Koikov, S. N. (Leningrad Polytechnic Inst.). Vysokomol. Soedin., Ser. B; 15: No. 3, 225-228(Mar 1973). (In Russian).

The beam from an electron projector was used to bombard 30-μ polytetrafluoroethylene film with 500 to 2000 eV electrons. The gaseous products H_2, He, CO, CO_2, and CH_4 were released, presumably sorbed on the surface and dissolved within the film, and also CF_3H and F_2 as breakdown products from the film itself. (KSW)

5329 FORMATION OF HYDRATED ELECTRONS IN AN ULTRASONIC FIELD. Margulis, M. A.; Mal'tsev, A. N. (Moscow State Univ.). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 11, 1697-1698(Nov 1972).

Translated from Zh. Fiz. Khim.; 46: No. 11, 2970-2971(Nov 1972).

The formation of hydrated electrons under the influence of ultrasonic waves has been discussed in recent years. Western workers state that hydrated electrons are not found among the products of the decomposition of water in an ultrasonic field; however evidence was obtained that these species may be formed. (auth)

5330 EFFECT OF γ-IRRADIATION AND OF A PROMOTING ADDITIVE ON ALUMINOSILICATE CATALYSTS IN THE OLIGOMERISATION OF ISOPENTENES. Panchenkov, G. M.; Kolesnikov, I. M.; Mamedova, S. L. (Moscow Inst. of the Petrochemical and Gas Industry). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 11, 1598-1600(Nov 1972).

Translated from Zh. Fiz. Khim.; 46: No. 11, 2804-2807(Nov 1972).

The introduction of 0.1 mass % of the acceptor additive 1,2-dichloroethane into a reactive mixture of isopentenes increases the yield of reaction products from 28.1% to 77.1%. The same proportion of a donor additive, diethyl ether, increases the yield from 27.7% to 49.6% with a time of contact of 80 min. Further increase in the quantity of a given additive lowers the yield of reaction products. (auth)

5331 CHEMILUMINESCENCE OF AQUEOUS FLUORESCEIN SOLUTIONS UNDER X IRRADIATION. Effect of pH. Pruetz, W. A. (Univ., Freiburg i. B.). Z. Phys. Chem. (Frankfurt); 83: No. 5-6, 309-321(1973).

The x-ray induced chemiluminescent reaction of e^-_{aq} with OH^- radicals of dyes was studied on aqueous fluorescein systems in the pH range 9 to 14. The pH-dependence of the chemiluminescence intensity perfectly fits the $1/(1 + 10^{pH/pK}$ (OH)) curve of the equilibrium OH reversible $O^- + H^+$. A pK(OH) of 11.94 was obtained in agreement with other literature values. O^- is more than ten times less efficient than OH in the corresponding chemiluminescent process. Relative rate constants for the reactions of e^-_{aq} and OH with various solutes, obtained from chemiluminescence quenching, are consistent with literature data. (GE)

5332 THERMAL-, PHOTOCHEMICAL-, AND RADIATION-INDUCED CHLORINATION OF BENZYL CHLORIDE AND BENZAL CHLORIDE. Kowalski, A.; Jezierski, M.; Bonczysty, A. (Politechnika, Lodz, Poland). Nukleonika; 18: No. 1, 1-9(1973). (In Polish).

Thermal-, photochemical- and γ radiation-induced methods of obtaining benzal chloride and benzotrichloride by chlorination of benzyl chloride and benzal chloride on laboratory scale were compared. The increase of chlorination rate with increasing temperature was observed. The uv radiation as γ radiation accelerates chlorination reaction in comparison with the thermal procedure. In the γ radiation procedure the rate of chlorination is proportional to root square of dose rate in the range from 0.032 to 0.341 Mrad/h. The quantum and radiation yield of the above mentioned processes was determined as well. (auth)

5333 RADIOINDUCED VAPOR-PHASE GRAFTING OF VINYLIDINE FLUORIDE TO COTTON TISSUE. Yul'chibaeva, S. G.; Yusupaliev, R. M.; Usmanov, Kh. U. (Tashkent State Univ.). Uzb. Khim. Zh.; No. 1, 60-62(1973). (In Russian).

Radiation-induced grafting of vinylidine fluoride in the vapor phase to cotton fiber was accomplished with an exposure to ^{60}Co-emitted γ-radiation, both in the presence of methanol or water vapor, and also without them. Polymer yield is enhanced, however, in the presence of such vapors. The sorption of water vapor by the irradiated/grafted copolymer was studied. The modified cotton tissue (with 5.6% vinylidine fluoride) possessed good water-repellency even after repeated laundering and a 35-hour exposure to uv radiation. (tr-auth)

5334 COPOLYMERIZATION OF VINYL ACETATE WITH VINYL PYRROLIDONE AND VINYL PYRIDINE. Larin, P. P.; Karabaev, A. Sh.; Tashmukhamedov, S. A.; Tillaev, R. S. (Tashkent State Univ.). Uzb. Khim. Zh.; No. 1, 38-41(1973). (In Russian).

The radiation-induced copolymerization of vinyl acetate (VA) with vinylpyrrolidone and also of VA with vinylpyridine under the influence of 0.125 MR (radiation source not specified) was studied. The copolymer samples were examined with an ir spectrophotometer over the interval 4000 to 500 cm^{-1}, and interpretation of the spectra is rendered in terms of the disappearance or appearance of absorption bands. With an increase of VA to 35% in the reacting VA–vinylpyrrolodone mixture, or to 50% in the case of VA–vinylpyridine, the change in the amount of poly(vinyl acetate) was insignificant; further increases in the VA mole fraction of the corresponding reacting mixtures brought about sharp increases in the poly(vinyl acetate) content of the resulting copolymers. (KSW)

5335 STUDIES OF JOSHI EFFECT IN METHANE UNDER X-RAY IRRADIATION EMPLOYING (I) SEMI-OZONIZER, AND (II) A SLEEVE DISCHARGE TUBE. Asolkar, G. V. (Inst. of Science, Nagpur, India). Agroplantae; 2: 74-84(1971).

The results of studies of Joshi effect in methane under x-ray irradiation employing a semi-ozonizer and a sleeve discharge tube are reported. The effect under x-rays in the pressure range studied (3 to 90 mm. Hg) is large, whereas the effect under visible light is inappreciable in this pressure range. Behavior of methane under electrical discharge in producing positive ions, free radicals and various chemical products is outlined. Results of scanning, the influence of irradiating different portions of the sleeves tube by a narrow beam of x-rays, is described. These show the significant role of the glass surface between the two sleeves. The results of the studies with methane are explained with suitable modifications of Joshi's theory taking into account the role of the glass surface, the positive ions, and the suggested double action of x-rays. (auth)

5336 EFFECT OF GAMMA RADIATION ON PURE PARAFFIN WAX AND ON WAX-ACETONE SYSTEM. Mayahi, M. V.; Mousa, M. M. (Baghdad Univ.). J. Indian Chem. Soc.; 49: No. 10, 981-984(Oct 1972).

The structure of Iraqi paraffin wax is found to be straight chain with no branching or unsaturation, with an average formula of $C_{34}H_{70}$ and an average molecular weight of 471. The effect of γ radiation on pure wax is to give degradation products containing some unsaturation. Cross-linking of these fragments, which occurs at 60 Mrads, give products of molecular weight less than twice the original. The effect on wax–acetone system (an emulsion) is that no degradation or cross-linking is observed, using up to 115.2 Mrads, thus there is complete protection by acetone. This emulsion case has not been reported before, and the Domain Effect is used for its explanation. (auth)

5337 RADIATION-INDUCED LIQUID PHASE POLYMERIZATION OF TETRAFLUOROETHYLENE AND ITS COPOLYMERIZATION WITH TRIFLUOROCHLOROETHYLENE AT LOW TEMPERATURES. Bruk, M. A.; Abkin, A. D.; Khomikovskii, P. M.; Kotin, E. B. (Scientific-Research Physical-Chemical Inst., Moscow). Vysokomol. Soedin., Ser. A; 15: No. 3, 488-497(Mar 1973). (In Russian).

A study was made of the radioinduced bulk polymerization of liquid tetrafluoroethylene (TFE) in the temperature range from −138 (supercooled liquid) to −100°, as well as of its copolymerization with trifluorochloroethylene (TFCE) in the temperature range −114 to −18°. On the basis of the data on the composition of copolymers, the radical mechanism of polymerization of TFE was established as well as of its copolymerization with TFCE at −100° and higher temperatures. A possible mechanism is suggested for the inhibiting effect of TFCE additions on liquid phase polymerization of TFE. The mutual solubility of TFE and TFCE in the solid state was investigated and the phase diagram composition–melting point for this system was obtained. It was found that TFCE and trifluoroethylene do not undergo polymerization under irradiation in solid phase. (auth)

5338 RADICAL POST-POLYMERIZATION IN SOLID IRRADIATED ACRYLIC ACID. Bol'shakov, A. I.; Mikhailov, A. I.; Barkalov, I. M.; Gol'danskii, V. I. (Inst. of Chemical Physics, Moscow). Vysokomol. Soedin., Ser. A; 15: No. 3, 470-477(Mar 1973). (In Russian).

The kinetic regularities of the radioinduced post-polymerization of crystalline acrylic acid (AA) were investigated. Under certain conditions of post-polymerization, a thermal explosion occurs. By using a differential scanning calorimeter for investigation of the process kinetics, it was possible to determine the propagation constant: $k_p \simeq 6 \times 10^{-12} \exp\{-11000 \pm 1500/RT\}\ cm^3\ sec^{-1}$. The post-polymerization of AA is characterized by "freezing" and "reviving" of the polymeric chain. Under isothermal conditions a kinetic termination of the process is observed, not associated with the disappearance of the active sites (freezing). With increase of the sample temperature, polymerization starts again (revival of the polymeric chain). From the ESR spectra of an irradiated single crystal of AA, in addition to the monomeric $CH_3\dot{C}HCOOH$ and growing polymeric $-CH_2\dot{C}HCOOH$ radicals, the $CH_2{=}\dot{C}COOH$ radical was identified. From the comparison of the data on a number of active sites, it is possible to assess the efficiency of the radicals arising during radiolysis at the initiation state of polymerization. (auth)

5339 PHOTO AND RADIATION INDUCED IONIC POLYMERIZATION. Hayashi, K.; Irie, M. (Hokkaido Univ., Sapporo). Pure Appl. Chem.; 34: No. 2, 259-263(1973).

Photoinduced cationic polymerizations of styrene and methylstyrene, which are weak electron donors and contain no hetero atom, were carried out in the presence of electron acceptors such as tetracyanobenzene and pyromellitic dianhydride to elucidate the polymerization mechanism initiated through an excited charge transfer interaction. Cyclohexene oxide was also polymerized by photo-illumination in the presence of these electron acceptors. The mechanism of this ring-opening polymerization was thought to be a cationic one. Photopolymerization of nitroethylene in tetrahydrofuran was carried out with the purpose of extending this process to anionic systems. The results obtained have been compared with the cases of ionic polymerizations by ionizing radiation and conventional catalysts. (auth)

5340 GAS-PHASE ISOPROPYLATION OF TOLUENE. On the Question of the Positional Selectivity in Gas-Phase Aromatic Substitutions. Cacace, F.; Possagno, E. (Univ., Rome). J. Amer. Chem. Soc.; 95: No. 10, 3397-3399(16 May 1973).

The isopropylation of toluene was carried out with gaseous i-$C_3H_7^+$ ions obtained by the γ radiolysis of C_3H_8 containing a radical scavenger and a low concentration of aromatic substrate. It was concluded that gas-phase electropholic attack of i-$C_3H_7^+$ on toluene is characterized, in analogy with the other gas-phase aromatic substitutions so far investigated, by a significant positional selectivity that can only be measured when extensive isomerization of the arenonium ions formed in the kinetically significant step of the attack is prevented by a suitable choice of the reaction conditions. (DHM)

5341 TRANSIENT ABSORPTION SPECTRA OF THE CHLOROPHYLL A ANION AND CATION. Seki, H.; Arai, S.; Shida, T.; Imamura, M. (Inst. of Physical and Chemical Research, Wako, Japan). J. Amer. Chem. Soc.; 95: No. 10, 3404-3405(16 May 1973).

The optical absorption spectra of both the anion and cation of chlorophyll (Chl a) were observed by the pulse radiolysis technique at room temperature as well as in rigid glasses irradiated with γ rays at 77°K. The absorption spectra of Chl a^+ were obtained in γ irradiated sec-butyl chloride glass at 77°K and in pulse irradiated benzonitrile solutions at room temperature. The absorption spectra of Chl a^- were obtained in γ-irradiated methyltetrahydrofuran glass at 77°K and in pulse-irradiated tetrahydrofuran solutions at room temperature. (DHM)

5342 ELECTRON SPIN RESONANCE AND PULSE RADIOLYSIS STUDIES OF IRRADIATED AQUEOUS SOLUTIONS OF 5-NITROURACILS. Oxidative Denitration by OH Radicals. Neta, P. (Carnegie-Mellon Univ., Pittsburgh); Greenstock, C. L. Radiat. Res.; 54: No. 1, 35-48(Apr 1973).

Radicals produced in irradiated aqueous solutions of 5-nitrouracil, 5-nitroorotic acid, and 5-nitrobarbituric acid were studied by the in situ radiolysis steady state ESR method, and the kinetics of their formation and disappearance were followed by pulse radiolysis. The reactions of hydroxyl radicals with 5-nitrouracil and its derivatives are nearly diffusion controlled and involve addition of OH to the 5,6 double bond. Addition of OH to the carbon bearing the nitro group leads to oxidative denitration by subsequent rapid elimination of HNO_2. This reaction is analogous to dehalogenation following OH addition to 5-halouracils, and the radicals produced from both the nitro and the halo compounds are identical. Addition of OH to position 6 is also important, but the radicals formed were not observed by ESR. The distribution of OH addition between position 5 and 6 was determined by the pulse radiolysis experiments and found to involve 25 and 30% addition to the 5 position of 5-nitrouracil and 5-nitrobarbituric acid, respectively, i.e., in these two cases the efficiency of oxidative denitration is 25 to 30%. The transient optical absorption spectra recorded immediately after the reaction of OH with 5-nitrouracil, 5-bromouracil, and iso-barbituric acid are very similar and are attributed to the same radical. The rate of reaction of OH has been monitored both by the buildup of the transient absorption and by the destruction of the parent compound absorption, and the two measurements give rate constants of $7 \pm 2 \times 10^9$ M^{-1} sec^{-1} for the four nitrouracil derivatives examined. These findings indicate that denitration, like dehalogenation, occurs rapidly following a rate limiting OH addition. Hydrated electrons were found to react with the 5-nitrouracils with rate constants of $1.9 \pm 0.2 \times 10^{10}$ M^{-1} sec^{-1} to produce the corresponding nitro anion radicals, which were identified by their ESR spectra. (auth)

5343 REACTIONS IN MICELLAR SYSTEMS. Wallace, S. C.; Thomas, J. K. (Univ. of Notre Dame, IN). Radiat. Res.; 54: No. 1, 49-62(Apr 1973).

Kinetic effects due to the solubilization of pyrene and biphenyl in aqueous surfactant solutions such as sodium dodecyl sulfate, hexadecyltrimethylammonium bromide, and polyoxyethylene dodecanol were investigated. Pulse radiolysis techniques were used to study the reactivity of the solubilized arenes with H· and e^-_{aq}, and laser photolysis techniques were developed to explore the effects of an interfacial barrier on the quenching of solubilized excited states. The reaction rates depend markedly on the nature of the micelle formed and the charge on the "probe" or reacting molecule. The data is discussed in terms of a dynamic theory of micelles in equilibrium with monomeric surfactant, and of arene dissolved in the micelle and the aqueous phase. (auth)

5344 ENERGY LEVEL STRUCTURE OF TRAPPED ELECTRONS IN 3-METHYLHEXANE GLASS FROM PHOTOCONDUCTIVITY AND OPTICAL BLEACHING STUDIES. Huang, T.; Kevan, L. (Wayne State Univ., Detroit). Contract AT(11-1)-2086. J. Amer. Chem. Soc.; 95: No. 10, 3122-3128(16 May 1973).

Electrons are trapped in γ-irradiated 3-methylhexane (3MH) glass at 77°K. Monochromatic photoexcitation produces photoconductivity and optical bleaching with a threshold near 1240 nm (1.0 eV) and a peak near 1000 nm (1.24 eV). This transition is linear in light intensity and independent of temperature between 77 and 4.2°K, so it is interpreted as a one photon transition directly to the conduction band or to an autoionizing state. Photoexcitation near 1650 to 1700 nm discloses a two photon transition which depends on the light intensity squared. The first photon corresponds to the well-known optical absorption of trapped electrons in 3MH at 1650 nm. This transition is interpreted as a 1s → 2p type. The 2p state then presumably crosses to an intermediate 2s-type state from which the second photon is absorbed. The threshold of the second photon transition was not determined but the transition appears to have a peak near 1700 nm. The temperature dependence of both optical bleaching and photoconductivity under photoexcitation with $\lambda > 1400$ nm shows that population of the intermediate 2s-type state involves an activation energy ~0.001 eV. The deduced energy level structure of trapped electrons in 3MH is remarkably similar to the structure in the more polar matrix, methyltetrahydrofuran. (auth)

5345 SOLID-STATE CHEMISTRY OF IRRADIATED CHOLINE CHLORIDE. Tomkiewicz, Y.; Agarwal, R.; Lemmon, R. M. (Univ. of California, Berkeley). J. Amer. Chem. Soc.; 95: No. 10, 3144-4149(16 May 1973).

Further details were established concerning the radiolysis of the α form of crystalline choline chloride. ESR studies at −196°C indicate the presence of a biradical, $(CH_3)_3N^+ \cdot\cdot CH_2CH_2OH{-}{-}{-}Cl^-$, that diffuses apart with rising temperature, and also indicate the presence of an ethanol monoradical. Radical-decay kinetics, radiolysis kinetics, thermoluminescence studies, and experiments with a photoelectron emitting dye all appear to confirm an important role for detrapped electrons in the radiolysis mechanism. (auth)

5346 MATRIX ENDOR STUDIES OF TRAPPED ELECTRONS AND HYDROGEN ATOMS. Helbert, J. N. Detroit; Wayne State Univ. (1972). 239p. University Microfilms Order No. 73-12,531. Thesis (Ph.D.).

ENDOR spectra of radiation produced trapped electrons in 10M NaOH, methanol, and 2-methyltetrahydrofuran glasses at 77°K were examined. In each glassy matrix, no ENDOR lines due to isotropic hyperfine couplings were observed, but matrix ENDOR lines at the free proton frequency were observed. The matrix ENDOR lines were analyzed in terms of a model proposed by Hyde, Rist, and Eriksson to give a value for the spatial extent of the trapped electron spin distribution. The ENDOR spectra due to trapped hydrogen atoms in irradiated sulfuric and phosphoric acid glasses and in polycrystalline ices containing their oxyanions were obtained and analyzed. A set of hyperfine lines were obtained as well as a matrix line for each trapped hydrogen system. In all four systems a value of the isotropic coupling constant for the nearest neighbor protons was obtained. The matrix ENDOR lines were analyzed in terms of the model by Hyde, Rist, and Eriksson to give a value of the spatial extent of the hydrogen spin distributions. (Diss. Abstr. Int., B)

5347 RADIATION-INDUCED POLYMERIZATION OF ACRYLAMIDE IN PRESENCE OF AMMONIA AT LOW TEMPERATURES. Sheinker, A. P.; Shkitov, A. M.; Kugel, T. E.; Abkin, A. D. (Scientific-Research Physical-Chemical Inst., Moscow). Vysokomol. Soedin., Ser. A; 15: No. 3, 766-772(Mar 1973). (In Russian).

A study was made of the γ-induced polymerization of acrylamide in the presence of ammonia at −91 to 0° in solution and in two-phase systems of crystalline acrylamide—saturated solution of acrylamide in ammonia. The intrinsic viscosity of polymer solutions increases with decreasing polymerization temperature, though the polymerization rate decreases. The reaction is inhibited by diphenylpicrylhydrazyl; acetonitrile, ethyl chloride, and triethylamine have no significant effect on the reaction rate. When acrylonitrile is added to acrylamide in liquid ammonia, an induction period sets in, whose length increases with decreasing temperature. The induction period is explained by the inhibition of the radical process of acrylamide polymerization by the complex or its transformation product amidine, formed during the interaction of acrylonitrile with ammonia. (auth)

5348 CONFORMATIONAL TRANSITIONS IN FIVE-MEMBERED CYCLIC RADICALS. Blyumenfel'd, A. L.; Trofimov, V. I. (Inst. of Chemical Physics, Moscow). Zh. Strukt. Khim.; 14: No. 2, 230-234(1973). (In Russian).

Temperature-influenced changes in EPR spectra of cyclic radicals $CH_2CH_2\dot{C}HCH_2CH_2$ and $CH_2CH_2CH_2\dot{C}HO$ in γ-irradiated clathrate hydrates of cyclopentane and tetrahydrofuran were investigated. These changes were associated with conformational transitions in five-membered rings. The form of the spectra as a function of the transitional frequency was calculated by computer. The frequencies of conformational transitions in the above radicals were determined as stabilized in the hydrate cavities. The frequency dependence on sample temperature was studied over a broad range of temperatures, from which was derived the activation energy of conformational transitions in the radicals investigated: 2700 cal/mole and 2100 cal/mole, respectively. (tr-auth)

5349 INFLUENCE OF ^{60}Co γ RADIATION ON β-CAROTENE SOLUTIONS. I. Qualitative and Quantitative Investigations of

Irradiated Petroleum Ether and n-Heptane Solutions. Bancher, E.; Washuettl, J.; Riederer, P. (Technische Hochschule, Vienna). Int. J. Vitam. Nutr. Res.; 42: No. 3, 355-361(1972). (In German).

The γ ^{60}Co-irradiation of β-carotene, dissolved into petroleum ether and n-heptane (4 Mrad; 1% solutions; oxygenation) showed a damage of β-carotene between 50 and 55%. Dilute solutions (1.2 mg/100 ml) were damaged totally in petroleum ether and n-heptane by irradiation with 500 and 1000 Krad, respectively. These investigations demonstrate a dependence of the damaging factor with the concentration of β-carotene. It was found that some of the resulting substances were vitamin-A-active: β-carotene-5,6-epoxide, β-apo-12′-carotinale, β-apo-10′-carotinale and vitamin-A$_1$-alcohole. The other substances are not vitamin-A-active: 4-keto-4′-hydroxy-β-carotene; 3,3′,6′-trihydroxy-α-carotene-5,8-epoxide. (auth)

5350 FORMATION AND CONVERSIONS IN FROZEN AQUEOUS SOLUTIONS OF GLUCOSE, 2-DESOXYGLUCOSE, AND 2 DESOXYRIBOSE DURING GAMMA IRRADIATION. Sharpatyi, V. A.; Sultankhodzhaeva, M. N. (Inst. of Chemical Physics, Moscow). Dokl. Akad. Nauk SSSR; 208: No. 5, 1157-1160(11 Feb 1973). (In Russian).

Frozen solutions of glucose, 2-desoxyglucose, and 2-desoxyribose in H_2O, D_2O, 5 M NaH_2PO_4, 4.5 M H_3PO_4, and 10 M KOH were irradiated with ^{60}Co γ radiation and studied with EPR at 77°K. The EPR spectra offered evidence of primary carbohydrate radicals, a reaction of unpaired electrons with α- and β-protons, water-splitting mechanisms to form a carbonyl group, and quantitative values for the appropriate g-factors. (KSW)

5351 CHANGES IN THE PHYSICAL AND CHEMICAL PROPERTIES OF PIVIACID AND ARGONA FIBERS DUE TO RADIATION STERILIZATION. Leonowicz, L.; Kroh, J. Pr. Inst. Wlokien., Lodz; 21: 35-64(1971). (In Polish).

The effect of exposure to γ radiation, over the range from 0.1 to 5 Mrad ($\times 10^4$ J/kg), on the strength parameters, molecular masses, solubility, crystallinity, crystallite orientation, and efficiency and durability of free radicals in Piviacid and Argona fibers was studied. Following exposure to 2.5 to 3 Mrad the average molecular mass of Piviacid fibers decreased by about 45% and that of Argona fibers decreased by 45 to 50%. The solubility of Piviacid fibers increased by about 17% and of Argona fibers by 50%. Index of crystallinity of Pivacid fibers was lower by 58 to 62% and of Argona fibers by about 33%. The total radiational output of free radicals at −196°C was $G_R \simeq 1.7$ in Piviacid and $G_R \simeq 0.8$ in Argona. The effect of oxygen on the processes of degradation and latticing of the tested polymers was determined. The radiational outputs for degradation were calculated to be $G_{(-)} = 5.8$ for Piviacid and $G_{(-)} = 6.6$ for Argona. Using gas chromatography the amounts of chlorine (0.51 mg/lg of fiber) and hydrogen chloride (0.4 mg/lg of fiber) issued from Piviacid fibers upon exposure to 2.7 Mrad were determined and their radiational efficiency was calculated ($G_{(CL)} = 5.1$; $G_{(HCL)} = 3.9$). An analysis of spectrophotometric changes in the macromolecular structures of the fibers gave a partial confirmation of the hypothetical molecular formula for extra-chlorinated polyvinyl chloride: (...-CH_2-CHCl-CHCl-CHCl-CH_2-CHCl-CH_2-CCl_2- ...). Since the known methods for measuring fiber solubility are inaccurate, an original method was used which consists in measuring the relaxation time of fiber inner stresses under the influence of solvents. On the basis of the results for radiation efficiency and life of the free radicals that originated in the tested fibers under sterilization an original method for modifying ready-made dressings without the necessity of addition is proposed. Functional relationships determining the essential changes in Piviacid and Argona macromolecules due to sterilizing doses of γ radiation were established. Additionally, the obtained results partially confirmed the hypothetical mechanism of ionizing radiation of extra-chlorinated polyvinyl chloride and viscose. (auth)

5352 INFLUENCE OF ^{60}Co γ RADIATION ON β-CAROTENE SOLUTIONS. II. Qualitative and Quantitative Investigation of Irradiated Tributyrin Solution. Bancher, E.; Washuettl, J.; Riederer, P. (Technische Hochschule, Vienna). Int. J. Vitam. Nutr. Res.; 42: No. 3, 362-367(1972). (In German).

γ-Irradiation of β-carotene soluted in tributyrin (oxygenation, 4 Mrad) showed the following products of radiolysis: β-carotene; 4-keto-4′-hydroxy-β-carotene; β-carotene-5-6-epoxide; β-carotene-5,6-5′-6′-diepoxide; vitamine-A$_1$-alcohol. Quantitative determinations (1000 mg/100 ml β-carotene) showed a damage of β-carotene of about 30.5%; the damage of β-carotene in dilute tributyrin solutions (2.5 mg/100 ml β-carotene) was not so effective as in solutions of petroleum ether and n-heptane. (auth)

5353 ELECTRON SPIN RESONANCE STUDIES OF γ-IRRADIATED HEXACYANORUTHENATE(II) IONS IN VARIOUS HOST LATTICES. Symons, M. C. R.; Wilkinson, J. G. (Leicester Univ., Eng.). J. Chem. Soc., Dalton Trans.; No. 9, 965-969(1973).

ESR data for γ-irradiated hexacyanoruthenate(II) ions doped into various host lattices (KCl, NaCl, KBr, NaBr) are reported. The main complexes formed are Ru(I) species (low-spin d^7), assigned as $Ru(CN)_4(CN')H_2O^{4-}$, $Ru(CN)_4(CN')_2^{5-}$, $Ru(CN)(CN')Hal^{5-}$, and $Ru(CN)_4(Hal)_2^{5-}$, where CN′ indicates a cyanide ligand tilted off the z-axis. The magnitudes of the hyperfine coupling to ruthenium and nitrogen are used to discuss the structures of the complexes. (auth)

Radiochemistry and Nuclear Chemistry

Refer also to abstracts 5640 and 5648.

Hot-Atom Chemistry

Refer also to abstract 5309.

5354 (COO-1617-36) HALOGEN ATOM REACTIONS ACTIVATED BY RADIATIVE NEUTRON CAPTURE AND ISOMERIC TRANSITION. Progress Report 7. (Nebraska Univ., Lincoln. Dept. of Chemistry). 1972. Contract AT(11-1)-1617. 29p. Dep. NTIS $3.50.

Progress is reported on a study of "hot atom" reactions of Cl, Br, and I in various gaseous, liquid, and solid halothanes, hydrocarbons, and other organic systems by using radiogas chromatography, solvent extraction technique, the freeze-thaw method, and other techniques for determining total organic and individual project yields induced by radiative neutron capture (n,γ), isomeric transition (IT), and other nuclear processes. (DHM)

5355 (NP-19740) TRANSPORT EFFICIENCY OF THE HELIUM-JET RECOIL-TRANSPORT METHOD WITH PURE HELIUM. Aysto, J.; Valli, K. (Jyvaskyla Univ. (Finland). Dept. of Physics). Feb 1973. 28p. Dep. NTIS (U. S. Sales Only) $3.50.

Techniques were developed for measuring the transport efficiency of the helium-jet recoil-transport method in the transport of radioactive recoil atoms. The dependence of the transport efficiency on main equipment parameters was studied experimentally using pure commercial-grade helium. The results are given in terms of helium mass throughput, capillary parameters and location of a catcher foil. High to moderate efficiencies were observed at transport distances shorter than 20 cm. Efficiencies obtained with pure helium at distances longer than 1 m are low, typically less than 1%. Possibilities for further development of the method are briefly discussed. (auth)

5356 YTTRIUM-HYDROGEN ISOTOPE COMPOSITIONS FOR RADIOCHEMICAL REACTIONS. Yannopoulos, L. N.; Jansson, S. A.; Gulbransen, E. A. U. S. Patent 3,716,491. 13 Feb 1973. Filed date 9 Jul 1969. 6p.

The use of yttrium deuterides and tritides and solutions of deuterium and tritium in yttrium alloys with titanium and/or zirconium for targets for radiochemical reactions is described. (DHM)

5357 STUDIES ON THE PREPARATION OF ORGANIC COMPOUNDS LABELLED BY ^{38}Cl. I. Inorganic Yields of ^{38}Cl in Szilard Chalmer Reactions of Aromatic Chloro Derivatives. Kim, Y. S. (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 5: No. 1, 44-54(Mar 1973).

In order to clarify an effective procedure of labeling organic chloro compounds by ^{38}Cl, phenylchloro derivative (7 kinds), chloronitrobenzenes (6 kinds), chloroanisoles (2 kinds), chloroanilines (3 kinds), chlorotoluenes (3 kinds), benzyl cholorides (4 kinds), and other samples (3 kinds) were irradiated in the TRIGA Mark-II research reactor and the inorganic ^{38}Cl yields were compared with the irradiation times after extracting the inorganic portion with an aqueous solution of alkali. It was found that the relative change between the inorganic ^{38}Cl yield and the irradiation time depends a great deal on the state of the sample, and a solid sample gave a lower and steady inorganic yield. The inorganic ^{38}Cl yield was decreased in the order of phenylchloro derivatives < chlorotoluene < benzyl chloride < cyclohexyl chloride < chloronitrobenzene < chloroaniline. Among compounds of a similar chemical structure, ortho and para isomers were shown to give a relatively small difference in their inorganic yields. A linear relationship was observed between the inorganic ^{38}Cl yield of homo functional compounds and the number of chlorine atoms on the benzene ring. Generally, polychloro substituted derivatives could give a higher yield than those of less chloro substituted. The results were discussed and the feasibility of these results for labeling purpose was criticized. (auth)

5358 MODERATION OF PHOTOCHEMICALLY PRODUCED HOT DEUTERIUM ATOMS. Fass, R. A.; Wong, D. L. (Pomona Coll., Claremont, CA). J. Phys. Chem.; 77: No. 11, 1319-1324 (24 May 1973).

The relative moderating efficiencies of various gases for hot deuterium atoms produced by photodissociation of DBr were determined. For deuterium atoms produced initially at 2 to 3 eV the moderators, in order of increasing efficiency, are Xe, Ar, Ne, CO_2, D_2, CD_4, and He. The results provide direct experimental evidence for an inelastic moderation mechanism with the polyatomic moderators, and are consistent with a "soft" interaction potential between D and He. The difficulty of achieving a completely "thermal" D atom population by this method is noted and discussed. (auth)

5359 RADIOCHEMICAL TRANSFORMATIONS AND REARRANGEMENTS IN ORGANOMETALLIC COMPOUNDS. Wiles, D. R. (Carleton Univ., Ottawa); Baumgaertner, F. Fortschr. Chem. Forsch.; No. 32, 63-108(1972).

The middle field between the Szilard–Chalmers reactions in ionic compounds and those in organic compounds (atom lies at center of molecule, these compounds geometrically similar to many ionic compounds, chemically more like organic compounds) is of special interest. The review deals with compounds having metal-to-carbon covalent bonds (sigma, π, other form of covalent bonding). Cyanide complexes or complex ions with N-, O-, S-bonding are excluded when the recombination processes seem to resemble those of ionic solids more than those of molecular organometallic compounds (mostly solids, with some liquids, and a few gases). All of these compounds are composed of discrete molecules without strong electronic interaction with each other. The radiochemical studies with organometallic compounds were carried out with isotope enrichment, molecular synthesis, and/or mechanistic investigation. (HK) (GF)

5360 STATE OF ^{32}P IN NEUTRON IRRADIATED ALKALI CHLORIDES. Maddock, A. G.; Mahmood, A. J. (Cambridge Univ., Eng.). Inorg. Nucl. Chem. Lett.; 9: No. 5, 509-511(May 1973).

It is stated to be difficult to determine the nature of the ^{32}P species present in neutron irradiated, ion implanted, or chemically doped chloride crystals containing atomically dispersed P. Ordinarily the P concentrations are such that no in situ methods of study are available. Radiochemical methods have usually involved solution of the crystals before analysis, generally in an aqueous solvent, and reactions occur between the crystal species and the aqueous solvent. An extensive study of ^{32}P distribution in irradiated crystalline chlorides was carried out using non-aqueous solvents. The results were very different from those obtained after aqueous solution and are believed to reflect more accurately the species in the irradiated crystals. A typical comparison is described for irradiated NaCl after solution in an aqueous medium and in liquid ammonia. The ammonia was found to be 2×10^{-2}M in phosphine and elemental white P. It is believed that the high proportions of the higher oxidation states of the ^{32}P usually reported are misleading and largely due to the reactions occurring during solution of the irradiated crystals. Full experimental details are given. (UK)

5361 SELECTIVE SEPARATION OF VOLATILE FISSION PRODUCT CHLORIDES FROM SOLID CHLORIDE SCAVENGERS. Neidhart, B.; Baechmann, K.; Kubny, S.; Link, I. (Technische Univ., Darmstadt, Ger.). (1972). 5p. (In German).

From meeting of lecturers in chemistry; Heidelberg, Germany (10 Apr 1972).

Mixtures of uranium tetrachloride (^{235}U 80% enriched) with solid chlorides (e.g. KCl, $SrCl_2$, YCl_3) were irradiated with thermal neutrons in a reactor. The volatility of the products which results from the reaction of the recoiling fission products with the chloride scavenger was studied in the temperature range 300 to 700°C. Selectivity and rate of emission as well as the amount of volatilized products depend on chloride matrix, temperature and carrier gas ($ZrCl_4$, $SbCl_5$, N_2, and CCl_4). The volatilization of Zr, Nb, Mo, Tc, Te, and I was studied and for some of these elements (e.g. Tc, Te) experimental conditions for a fast, selective volatilization with high yield could be defined. These target materials can therefore be used in reactor on-line experiments for the study of short-lived neutron-rich fission nuclides. (GE)

5362 ANALYSIS OF THE KINETICS OF SOLID-STATE REACTIONS IN THE COURSE OF SLOWING-DOWN OF ^{38}Cl- AND ^{82}Br-RECOIL ATOMS IN THE SYSTEM $K_2[ReBr_6]/K_2[ReCl_6]$. Roessler, K.; Otterbach, J. (Kernforschungsanlage, Juelich, Ger.). (1972). 24p. (In German).

From meeting of lecturers in chemistry; Heidelberg, Germany (10 Apr 1972).

In neutron-irradiated mixed crystal system $K_2[ReCl_6]-K_2[ReBr_6]$ only the monosubstituted pentabromochloro (^{38}Cl) and pentachlorobromo (^{82}Br) complexes can be found, besides the labelled original complexes and the radiohalogenides (${}^{38}Cl^-$, ${}^{82}Br^-$). Because of the simplicity of the system, conceptions of solid-state physics may be applied in order to get a deeper theoretical knowledge of the recoil phenomena in that system. Radiochemical yields of the different products, separated by gel electrophoresis and measured by γ spectrometry were determined as a function of the molar ratio. An attempt was made to explain the results by means of mathematical functions. Judging from zero-order, first-order, and second-order terms, reaction mechanisms were defined which permit the explanation of different recoil behavior of chlorine and bromine. The postulated mechanisms were supported by computer calculations with simplified models, as are commonly used in solid-state physics. (GE)

Properties of Radioactive Materials

Refer also to abstracts 5138, 5185, 5186, 5240, 5244, and 5964.

5363 (ANL-7972, pp 31-33) CONTINUOUS CONVERSION OF U/Pu NITRATES TO OXIDES. Levitz, N. M.; Grosvenor, D. E.; Teats, F. G.; Quattropani, N. Dec 1972.

Studies are continuing on a fluidized-bed process for converting uranyl nitrate–plutonium nitrate solutions to homogeneous oxide powder suitable for the fabrication of fuel shapes (pellets). In successive steps, the mixed nitrate solutions are denitrated to UO_3-PuO_2 powder and the UO_3-PuO_2 is reduced with hydrogen to yield UO_2-PuO_2 powder, the required material for fuel manufacture. Current emphasis is on the denitration step, using pilot-scale equipment installed in a 3- by 4-module glovebox, but work on the reduction step has been initiated. (DHM)

5364 (JEN-253) APPLICATIONS OF THE GAS CHROMATOGRAPHY IN THE NUCLEAR SCIENCE AND TECHNOLOGY. Gasco Sanchez, L. (Junta de Energia Nuclear, Madrid (Spain). Division de Quimica). 1972. 56p. (In Spanish). Dep. NTIS (U. S. Sales Only) $5.00.

A review is presented on the applications of the gas chromatography in nuclear science and technology published up to December 1971. Its contents are classified under the following heads: (I) radiogas chromatography, (II) isotope separation, (III) preparation of labelled molecules, (IV) nuclear fuel cycle, (V) nuclear reactor technology, (VI) irradiation chemistry, (VII) separation of metal compounds in gas phase, and (VIII) applications of the gas chromatography carried out at the Junta de Energía Nuclear, Spain. Chapter VIII only includes the investigations carried out from January 1969 to December 1971. (auth)

5365 (LIB/Trans-501) BEHAVIOUR OF THE Tc(IV) AT INDICATOR LEVEL IN A NON-COMPLEXING MEDIUM. Guennec, J. Y.; Guillaumont, R. Translated from Radiochem. Radioanal. Lett.; 13: No. 1, 33-38(1973). 12p. Dep. NTIS $3.00.

Evidence for the cationic Tc(IV) ion $TcOOH^+$ was found by solvent extraction of reduced Tc(VII) perchlorate solution. Hydrolysis constant of this cation is about 10^{-1}. (auth)

5366 (SAN-849-2) SYNTHESIS AND EVALUATION OF ^{11}C LABELED ORGANIC COMPOUNDS FOR USE IN NUCLEAR MEDICINE. Second Annual Report. Lin, T. H.; Winchell, H. S. (Medi-Physics, Inc., Emeryville, Calif. (USA)). Mar 1973. Contract AT(04-3)-849. 12p. Dep. NTIS $3.00.

5367 DEVELOPMENT OF RADIOISOTOPE PRODUCTS IN PHARMACEUTICAL COMPANY. Kato, S. (Dainabot Radioisotope Labs. Ltd., Tokyo). Genshiryoku Kogyo; 18: No. 11, 20-23(Nov 1972). (In Japanese).

The present state and future prospect of radiopharmaceuticals are discussed with reference to available data. The use of radioisotopes for nuclear medicine in Japan has doubled during past 5 years, being increased from a total dose of 137 Ci in 1967 to 270 Ci in 1971 due to recent increase in the use of ^{99m}Tc and ^{99}Mo in particular. The use of ^{198}Au, ^{51}Cr, and ^{32}P, which can be obtained in this country, was merely 20% of the total dose of radioisotopes used for the field of medicine in 1971 and the rest of radioisotope supply depends on import from abroad. National production of short-lived radionuclides and development of their application techniques should be highly promoted in the field of medicine. The development of radioisotope production in the U. S. A. and in Japan is discussed regarding cyclotron produced radioisotopes and prospective application of ^{99m}Tc. Further application of radiopharmaceuticals for radioimmunoassay in vitro, tracers, various measuring methods and sterilization are also discussed with respect to future development. (Japan)

5368 CHRONOPOTENTIOMETRIC STUDY OF THE REACTION Am(III) + 3e → Am(0) IN MOLTEN LiCl–KCl EUTECTIC.

Martinot, L. (Univ., Liege); Spirlet, J. C.; Duyckaerts, G.; Muller, W. Anal. Lett.; 6: No. 4, 321-326(Apr 1973).

A chronopotentiometric study of the reaction Am(III) + 3e → Am(0) in molten LiCl–KCl is reported. The diffusion coefficient $D_{Am(III)}$ increases from 3.5 to 26.0 10^{-6} cm^2 sec^{-1} when the temperature was raised from 400 to 650°C. The mechanism of the diffusion is discussed on the base of the hole theory for molten salts. (auth)

5369 LIQUID CHROMATOGRAPHIC PURIFICATION OF CARBON-11 LABELED GLUCOSE. Straatmann, M.; Welch, M. J. (Washington Univ., St. Louis). Int. J. Appl. Radiat. Isotop.; 24: No. 4, 234-236(Apr 1973).

A method proposed by Noggle and Bolomey (Plant Physio.; 26: 174(1951)) has been adapted for the liquid chromatographic purification of ^{11}C-labelled glucose so that the separation time is reduced to an acceptable level by increasing the flow rate and temperature. The method is described. It is shown that 90% of the glucose was eluted after 26 min while fructose is still eluting in appreciable amounts after 34 min. By collection of the eluate in the 20 to 30 min interval a 16% concentration of ^{11}C-fructose is present in the final solution. Interdependence of slower flow rate and/or longer column to enhance resolution against specific activity is discussed. This revised preparation for ^{11}C-labelled glucose is superior to the former procedure in ease of handling, purity of final product, and substantial enrichment of ^{11}C-glucose as compared to the ^{11}C-fructose. Furthermore, these advantages are achieved with little expense to the time of preparation of specific activity in the final product. (UK)

5370 REACTIVITY OF APDT [1,2-DIAMINOPROPANE-TETRA-ACETIC ACID (DISODIUM SALT)] WITH CATIONS. Vicente-Perez, S.; Hernandez, L.; Hernandez, M. (Faculty of Science, Badajoz, Spain). Inform. Quim. Anal., Pura Apl. Ind.; 26: No. 1, 30-43(1972). (In Spanish).

Reactions of APDT include the formation of a precipitate with Ag(I), Sb(V), and U(VI), the reduction of Ce(IV) to Ce(III), of Au(III) to the metal and of V(V) to V(IV), and the dismutation of Hg(I) into Hg(II) and the metal. Colored complexes are formed with Co(II), Cu(II), Cr(III), Fe, Ni(II), Pd(II), PT(IV), U(VI), and V(V), also with Co(III), Mn(III), and V(IV); colorless complexes are formed with many other cations. The reactions are mostly fairly sensitive; that with Cr(III) is highly sensitive. (Anal. Abstr.)

5371 DECOMPOSITION OF ALIPHATIC ALCOHOLS ON TECHNETIUM. Spitsyn, V. I.; Pirogova, G. N.; Korosteleva, R. I. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 208: No. 4, 878-880(1 Feb 1973). (In Russian).

Small quantities of Tc (0.16 to 0.27 wt.%) were deposited on Al_2O_3 which functioned as a carrier; the mixture was then used as a catalyst in a study of the dehydrogenation of methyl, ethyl, n-propyl, isopropyl, and n-butyl alcohols between 150 and 300°C. Side reactions were not detected with the methyl, ethyl, and isopropyl alcohols; the normal propyl and butyl alcohols also formed hydrogen, but this reaction was accompanied by side reactions. The dehydrogenation of isopropyl alcohol was characterized by the largest reaction rate and the lowest initiating temperature (150°C). (KSW)

5372 PREPARATION OF RADIOACTIVE STANDARDS IN THE NATIONAL METROLOGICAL BUREAU. Szokolyi, L.; Szorenyi, A. (Orszagos Meresugyi Hivatal, Budapest). Izotoptechnika; 16: No. 3, 123-134(Mar 1973). (In Hungarian).

Topics discussed include radiochemical problems and techniques, activity measurement methods and instruments, and data evaluation. (auth)

5373 POSITION AND MOBILITY OF WATER IN $UF_4 \cdot 2.5\ H_2O$ BY THE NMR METHOD. Matsutsin, A. A.; Zadneprovskii, G. M.; Falaleeva, L. G. (Inst. of Chemistry, Vladivostok, USSR). Zh. Strukt. Khim.; 13: No. 5, 814-822(1972). (In Russian).

Effective values of the dipole components and the asymmetry of the local field about the nuclei were found from NMR spectra of ^{19}F and ^1H for the crystal $UF_4 \cdot 2.5H_2O$. The results were compared with values calculated on the basis of known positions of the paramagnetic ions of U^{4+}. The position of the water molecules and localized protons were confirmed. The mobility of a portion of the water molecules was demonstrated. (KSW)

5374 STORAGE OF THE SOLUTION OF ^{14}C-LABELLED 3,4-DIHYDROXYPHENYLALANINE FOR DECARBOXYLASE ASSAY. Drsata, J.; Hais, I. M.; Chmelar, V. (Charles Univ., Prague). Int. J. Appl. Radiat. Isotop.; 24: No. 4, 231-232(Apr 1973).

Radiometry of ^{14}C-carbon dioxide set free by enzymatic decarboxylation of ^{14}C-carboxyl-labelled 3,4-dihydroxyphenylalanine (DOPA) represents a very sensitive method for the assay of aromatic amino acid decarboxylase. However during storage, problems arose due to the non-enzymic decarboxylation of DOPA-1-^{14}C in the stock solution. The extent of this non-enzymic decarboxylation was evaluated as the function of time spent in aqueous solution under aerobic conditions at 37°C. The influence of pH, anaerobic conditions and ascorbic acid were also studied in order to find optimal conditions for the storage of DOPA in a state allowing its use as a substrate for enzymic assay. (UK)

5375 USE OF RADIOACTIVE KRYPTONATES IN SOLVING PHYSICOCHEMICAL PROBLEMS OF MACROMOLECULAR SUBSTANCES. I. Preparation of Radioactive Kryptonates of Macromolecular Substances. Toelgyessy, J.; Cik, G.; Lesny, J.; Lukac, P.; Varga, S. Jad. Energ.; 19: No. 5, 161-163(May 1973). (In Slovak).

Methods for incorporating ^{85}Kr in compounds by a diffusion technique or by ion bombardment of accelerated ^{85}Kr ions were studied as applied to polyvinyl chloride, polypropylene, polystyrene, poly(methyl methacrylate), and the polyamide of caprolactam. The results are discussed from the point of view of their use in attacking physicochemical problems concerning the polymers listed. (tr-auth)

5376 SOME PROBLEMS OF THE PREPARATION OF RADIOACTIVE STANDARDS. Barta, T.; Jedlovszky, R.; Szorenyi, A. (Orszagos Meresugyi Hivatal, Budapest). Izotoptechnika; 16: No. 3, 135-148(Mar 1973). (In Hungarian).

Some topics discussed are control of radioisotopic purity, inaccuracy of radioactive concentration values, and importance of international comparative measurements. (auth)

5377 CRYSTAL STRUCTURE OF $K_3(UO_2)_2F_7 \cdot 2H_2O$. Mikhailov, Yu. N.; Udovenko, A. A.; Kuznetsov, V. G.; Davidovich, R. L. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Strukt. Khim.; 13: No. 5, 942-943(1972). (In Russian).

A study of the structure of single crystals of $K_3(UO_2)_2F_7 \cdot 2H_2O$ revealed a prismatic habit, and was comprised of chains of $[(UO_2)_2F_7]^{3-}$, between which K ions and H_2O molecules were situated. The monoclinic crystal was characterized by a = 6.234, b = 9.313, c = 11.603, with $\gamma = 94°\ 24'$. Other crystal parameters are tabulated. (KSW)

5378 INFRARED SPECTRA OF COMPLEX COMPOUNDS OF URANYL FLUORIDE WITH WATER AND HYDROGEN FLUORIDE. Tsvetkov, A. A.; Seleznev, V. P.; Sudarikov, B. N.; Gromov, B. V. (Moscow Chemical-Technological Inst.). Zh. Neorg. Khim.; 18: No. 3, 783-786(Mar 1973). (In Russian).

The infrared absorption spectrum of some aquocomplexes of fluorine-containing uranyl compounds was investigated, and force constants of U–O bonds were calculated. Typical compounds studies are: $UO_2F_2 \cdot nH_2O$ (n = 1,2,3, or 4), $UO_2(OH)F \cdot H_2O$, $UO_2(OH)F \cdot 2H_2O$, $UO_2F_2 \cdot 2HF \cdot 4H_2O$, $UO_2F_2 \cdot HF \cdot 2H_2O$, $UO_2F_2 \cdot 0.5HF \cdot 1.5H_2O$. (KSW)

5379 USE OF APDT [1,2-DIAMINOPROPANE-NNN′N′-TETRA-ACETATE ACID] AS MASKING AGENT IN GENERAL REACTIONS OF CATIONS. Vicente-Perez, S.; Hernandez, L.; Hernandez, M. (Faculty of Science, Badajoz, Spain). Inform. Quim. Anal., Pure Apl. Ind.; 26: No. 2, 77-83(1972). (In Spanish).

The behavior of cations towards various reagents in the presence of a slight excess of complexan (I) was examined. With 2N-NaOH, Ag(I), Bi(III), Fe(III), Mn(II), U(VI), Pt(IV), Th(IV), Tl(III), La(III), Mg(II), Be(II), Sb(III) and Sn(IV) are precipitated, but not Al(III), Ce(III), Hg(II) or Sn(II). With 2N-aqueous NH_3, Mn(II), U(VI), Be(II), Sb(III), and Sn(IV), and with saturated Na_2CO_3 solution, Mn(II), Ca(II), Be(II), Sb(III), and Sn(IV) are precipitated. All the precipitates are soluble in excess of I solution except those formed by Ag(I) and Sn(IV). With Na_2S, the sulfides of Ag(I), Tl(I), Pb(II), Hg(II), Bi(III), Cu(II), Cd(II), Pd(II), Sn(II), Sn(IV), Fe(II), Pt(IV), Mo(VI), V(V), U(VI), As(III), As(V), Sb(III), and Sb(V), which are insoluble in excess of I, are precipitated, but not those of Ni(II) or Co(II). The change in color of certain metal complexes in the presence of I was also studied. (Anal. Abstr.)

5380 ELECTROLYTIC ANTI-BODY LABELING WITH ^{99m}Tc IN A CLOSED SYSTEM. Hebestreit, H. P. (Heidelberg Univ., Mannheim, Ger.). (1972). vp. (In German).

From tenth annual meeting of the Society for Nuclear Medicine; Freiburg i. B., Germany (27 Sep 1972).

A method is described with which it is possible to label immunoglobulins with ^{99m}Tc without any denaturation or loss of efficiency. (GE)

5381 PROBLEMS OF LABELING ERYTHROCYTES WITH ^{99m}Tc–PERTECHNETATE. Buell, U.; Frey, K. W.; Knapp, N. (Univ., Munich). (1972). vp. (In German).

From meeting: nuclear medicine and radiochemistry; Freiburg i. B., Germany (27 Sep 1972).

Effectiveness and reliability of the labelling of erythrocytes with ^{99m}Tc from the eluate of a radioisotope generator was carefully checked. The material of the syringes and the containers used for incubation influences the effectiveness of labelling; the effectiveness was decreased considerably in the case of plastics (one-way syringes). (GE)

5382 RADIOACTIVE INERT GASES. Balek, V. (Karlova Univ., Prague). Vesmir; 50: No. 9, 278-282(1971). (In Czech).

A review is presented of the uses of radioactive inert gases especially Rn and ^{85}Kr. (DHM)

5383 ELECTROCHEMISTRY OF ACTINIDES IN MOLTEN SALTS. Martinot, L. (Univ., Liege); Caligara, F. At. Energy Rev.; 11: No. 1, 3-61(Apr 1973).

The electrochemical fundamental research concerning the actinides is reviewed. The methods employed in the investigation of molten salts, e.m.f. measurements, chronopotentiometry, voltammetry, together with their practical modifications for high-temperature work, are discussed. The electrochemical properties of Th(II), Th(IV), U(III), U(IV), UO_2(V), UO_2(VI), Np(III), Np(IV), NpO_2(V), NpO_2(VI), NpO_5(VII), Pu(III), Pu(IV), and PuO_5(VII) were classified. (auth)

5384 CHEMICAL CONSEQUENCES OF BETA-DECAY. I. Beta Decay of UX_1(^{234}Th) in Thorium−2 Thenoyltrifluoracetonate. Macasek, F.; Drienovsky, P.; Kopunec, R.; Mikulaj, V. (Comenius Univ., Bratislava). Acta Fac. Rerum Natur. Univ. Comenianae, Chim.; 15: 33-49(1971). (In German).

The distribution was studied of UX_2(^{234}Pa) between the aqueous and the organic phases resulting from beta decay of UX_1(^{234}Th) in thorium 2-thenoyltrifluoracetonate (Th(UX_1)TTA_4). Possible applications of this process in the study of the extraction equilibrium of mother- and daughter-chelates were discussed. When extracting Th(UX_1)TTA_4 into an aqueous chloride buffer solution 2.53% ± 9% of the equilibrium amount of UX_1 was found in the organic phase. The distribution of ^{233}Pa in a similar system reached the value close to that corresponding to the extraction equilibrium. The coprecipitation of hydrolyzed forms of UX_2 with Mn(IV) oxide hydrates proved that 79% ± 3% of UX_2 resulting from the beta decay of UX_1 remained bonded in the chelate chain. Various mechanisms of this process were discussed but the final conclusion can be only drawn from the separation in gaseous phase when the existence of volatile Pa acetylacetonate is expected. (NSA of Czechoslovakia)

5385 CONDUCTIMETRIC STUDY OF ION HYDRATION. XI. The Hydration of Silver(I) and Thorium(IV) Ions. Gusev, N. I. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 11, 1657-1658(Nov 1972).

Translated from Zh. Fiz. Khim.; 46: No. 11, 2912-2913(Nov 1972).

It was shown in a study of the hydration of Ag^+ and Th^{4+} that the numbers of water molecules oriented by the cations are $n_M \cong 3$ and $n_M \cong 20$ for Ag^+ and Th^+ respectively. (auth)

5386 CONVERSION OF URANIUM HEXAFLUORIDE TO URANIUM DIOXIDE. Brandberg, S. G. (ASEA-ATOM, Vaesteraes, Sweden). Nucl. Technol.; 18: No. 2, 177-184(May 1973).

Four different methods for the conversion of UF_6 to ceramic grade UO_2 powder were developed to an industrial scale. Two of them, the ADU and AUC processes, are based on precipitation of uranium compounds from aqueous solutions. The other two follow a dry route in which UF_6 is decomposed and reduced by steam and hydrogen in either fluidized beds or rotating kilns. The quality requirements for the conversion products, UO_2 powder, are closely related to the quality of the sintered pellets. An important requirement is the influence of the conversion process and its process parameters on sintered density. The aqueous AUC process is attractive, particularly if UNH is also to be processed. The dry processes are, however, expected to become of increasing importance. Rotating kilns have some favorable features as compared to fluidized beds. (auth)

5387 ELECTRODEPOSITION OF URANIUM COMPOUNDS. Jostan, J. (to Licentia Patent-Verwaltungs GmbH). German Patent 2,131,081. 11 Jan 1973. 8p. (In German).

This patent refers to a procedure for the electrodeposition of adhesive uranium-containing layers, with a uranium compound (U_3O_8 or uranyl nitrate) being embedded into a likewise electrodeposited metal matrix (copper or nickel). The compound is precipitated either out of a nickel bath in which the uranium oxide is suspended, or out of an electrolyte containing dissolved uranyl nitrate or copper nitrate. Thus uranium oxide is embedded into the nickel layer, or uranium-containing copper layers are deposited. The adhesive strength of the layers can be improved by the action of ultrasonic waves on the cathode which can be applied either continuously over the whole electrolytic process or periodically and/or by varying the movement of bath and/or cathode, or by periodically altering the current density at the cathode. (GE)

5388 SIMPLE AND CHEAP REMOTELY OPERATED SYSTEM FOR THE IODINATION OF PROTEINS. Henville, A.; Jenkin, G. (Animal Research Council, Cambridge, Eng.). Anal. Biochem.; 52: No. 2, 336-341(Apr 1973).

The manipulations involved proved to be uncomplicated and rapid, the whole procedure taking only 20 min. There was 70% attenuation of radioactivity by the Perspex front panel as measured at the site of the operator. Further attenuation could be achieved at an increased cost by replacing the Perspex screen by a heavy plate glass front. The technique was used routinely in our laboratory for the iodination of LH and FSH for twelve months, during which time twenty successful preparations were made. The apparatus described could be adapted to any small scale reaction involving nonvolatile noxious chemicals, including radioisotopes. (auth)

5389 PREPARATION OF DI-π-CYCLOOCTATETRAENE COMPLEXES OF URANIUM, THORIUM, AND PLUTONIUM BY DIRECT REACTION OF THE METALS WITH CYCLOOCTATETRAENE. Starks, D. F.; Streitwieser, A. Jr. (Univ. of California, Berkeley). J. Amer. Chem. Soc.; 95: No. 10, 3423-3424(16 May 1973).

The di-π-cyclooctatetraene complexes of uranium, thorium, and plutonium were prepared by heating the metals with cyclooctatetraene at 150°C. The highest yield obtained for the uranium complex was 57%. (DHM)

5390 METHOD FOR DISSOLVING PLUTONIUM DIOXIDE. Deaton, R. L.; Silver, G. L. (to United States Atomic Energy Commission). U. S. Patent 3,725,294. 3 Apr 1973. Filed date 27 Jan 1972. 4p.

A method for dissolving refractory plutonium dioxide is presented. The method involves heating plutonium dioxide under controlled temperature, pressure, and atmosphere conditions for a sufficient time until the conversion to a lower oxide, such as diplutonium trioxide, is generally effected, cooling under controlled conditions to prevent reoxidation, and dissolving the cooled product with a suitable acid or acid mixture. (auth)

5391 URANYL MONO-N-BUTYL PHOSPHATE. Solovkin, A. S.; Teterin, E. G.; Shesterikov, N. N. Zh. Neorg. Khim.; 18: No. 3, 787-791(Mar 1973). (In Russian).

The formation, composition, and solubility of the compounds which separated during the reaction of uranyl nitrate with mono-n-butyl phosphate in aqueous nitric acid solutions were studied. Infrared spectrometric studies of these compounds were utilized to derive bond character information and the structure of uranyl mono-n-butyl phosphate. (tr-auth)

5392 PRODUCTION OF UF_4 BY ELECTROLYTIC REDUCTION. I. Laboratory Scale Studies. Gispert Benach, M.; Hernandez Arroyo, F.; Montes Ponce de Leon, M.; Rojas de Diego, J. L. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 16: No. 80, 623-636(1972). (In Spanish).

A variant in the reduction of U(VI) to U(IV) using electrolytic reduction was studied. These studies made on a laboratory scale for the development of an electrolytic cell adequate for the process are described. The studies include materials testing, the determination of the optimum electrolyte concentration and pH, the determination of adequate current density, the cell geometry, and the possibilities of electrolysis in various stages. The complementary operations of sedimentation, washing, and recovery of the mother water, drying, and dehydration of the product were also studied on a laboratory scale. The cell model developed with lead electrodes and PVC container offers the advantages of a very acceptable conversion yield to U(IV), low cost, and simple construction. The limitations of the operating temperature, frequent cleaning of the anode rods, and a relatively low current density. (tr-auth)

5393 STUDY OF THORIUM 1 : 1 COMPLEXES WITH CATECHOL AND WITH 3,4-DIHYDROXYBENZENESULFONIC ACID. Bartusek, M. (Purkyne Univ., Brno). Spisy Prir. Fak., Univ. Brne; No. 517, 397-405(1970).

Thorium forms a stable complex with either reagent at pH 2 to 3 provided that an excess of reagent is used to prevent hydrolysis of free Th^{4+}, which begins at pH <2.7. At pH 4 to 5 a precipitate is formed, which dissolves at pH >6.4 in the presence of an excess of reagent. (Anal. Abstr.)

5394 REDUCTION OF MENDELEVIUM TO THE MONOVALENT STATE. Mikheev, N. B.; Spitsyn, V. I.; Kamenskaya, A. N.; Rumer, I. A.; Gvozdev, B. A.; Rozenkevich, N. A.; Auerman, L. N. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 208: No. 5, 1146-1149(11 Feb 1973). (In Russian).

An ethanol solution of chlorides of rare earth elements and HCl containing Md^{3+} was reduced by metallic Mg to Md^{+} at the same time Eu^{3+} was being reduced to Eu^{2+}. The entrapment of microquantities of Yb^{2+}, Eu^{2+}, Sr^{2+}, Yb^{3+}, Y^{3+}, Eu^{3+}, Cf^{3+}, and Fm^{3+}, by salts of alkali metals was studied. (KSW)

5395 CRYSTAL STRUCTURE OF $Na_2[UO_2(OXYDIACETATE)_2] \cdot 2H_2O$. Bombieri, G.; Graziani, R.; Forsellini, E. (Consiglio Nazionale delle Ricerche, Padua). Inorg. Nucl. Chem. Lett., 9: No. 5, 551-557(May 1973).

Crystal data are reported for oxydiacetatodioxobis(pyridine oxide) uranium (VI), $UO_2(ODA)(PyO)_2$, together with the crystal structure of $Na_2[UO_2(ODA)_2] \cdot 2H_2O$. The former is monoclinic, a = 19.89, b = 8.22, c = 10.85Å, β = 101.37°, space group $P2_1/c$, and its most probable structure involves two neutral ligands and the anionic ligand ODA coordinated to U in the equatorial plane. The latter is monoclinic, a = 19.84, b = 13.22, c = 7.14Å, β = 97.16°, space group $P2_1/C$. The U atoms lie in two sets of special positions with site symmetry I, (0,0,0; ½,0,0), so that there are two independent sets of centrosymmetric molecules in the cell). The anionic ligands act as tridentate ligands, and coordination eight to U is realized by an irregular hexagon of six O atoms bonded in the base plane normal to the linear UO_2 group. The Na ions are surrounded by the carboxylic O's in an approximately octahedral configuration. The anionic complex units are linked in an infinite three-dimensional network. (UK)

5396 CHEMICAL CONSEQUENCES OF THE β-DECAY OF ^{147}Nd IN TRIS(CYCLOPENTADIENYL)NEODYMIUM. Kopunec, R.; Macesek, F.; Mikulaj, V. (Comenius Univ., Bratislava). Chem. Zvesti; 27: No. 1, 14-22(1973).

The main chemical form of the stabilization of ^{147}Pm produced by the β-decay of ^{147}Nd in tris(cyclopentadienyl)neodymium was determined. The accumulation of daughter products took place in the crystals of the parent compound, and their separation was carried out by a sublimation method. Under the conditions employed, the main chemical form of the stabilization of ^{147}Pm is $(C_5H_5)_3Pm$ with yields of 91.3 ± 3.5%. The remainder consists of some chemical forms which are not volatile at 180°C and 10^{-4} torr and have not been defined as yet. (auth)

5397 STABILIZATION OF DAUGHTER ^{99m}Tc AFTER THE β-DECAY OF ^{99}Mo IN DIHYDRIDOBIS(CYCLOPENTADIENYL) MOLYBDENUM-(^{99}Mo). Mikulaj, V.; Macasek, F.; Kopunec, R. (Comenius Univ., Bratislava). Chem. Zvesti; 27: No. 1, 23-31 (1973).

The chemical forms of the stabilization of daughter ^{99m}Tc after the β-disintegration of ^{99}Mo in Mo-99-labeled dihydridobis (cyclopentadienyl)molybdenum were investigated by radiochemical methods. It was found that ^{99m}Tc is stabilized in high yield in a chemical form which was identified as hydridobis(cyclopentadienyl)technetium. Sublimation with temperature gradient and paper chromatography were used for separation of the parent substance from $(C_5H_5)_2{}^{99m}TcH$. The yield of $(C_5H_5)_2{}^{99m}TcH$ was determined by sublimation (88 ± 2%) and paper chromatography (94 ± 4%) if the daughter ^{99m}Tc was accumulated in the crystals of parent substance. Provided the decay took place in benzene or 3N HCl, the yield was determined by paper chromatography and extraction (79 ± 3%). (auth)

5398 STUDIES IN THE ELECTROCHEMISTRY OF URANIUM AND COBALT. Farrington, G. C. Cambridge, MA; Harvard Univ. (1972). 126p. University Microfilms Order No. 73-10,955. Thesis (Ph. D.).

A powerful reductometric titrant, +3 uranium, was generated in acidic solution with nearly 100% current efficiency and applied to the determination of +6 uranium. The titration error is +0.09% with a 211 mg sample of uranium. The potentiometric titration curve for the titration of +6 uranium with +3 uranium showed that the UO_2^{++}/UO_2^{+} couple is potential determining in mixtures of +6, +5, and +4 uranium. A brief review of the literature dealing with the standard potentials of the various uranium couples led to the conclusion that several of the presently accepted values are inaccurate. Investigation of the electrochemistry of +2 cobalt in glacial acetic acid was directed towards characterizing the preparation and properties of +3 cobalt solutions for use as oxidants in organic applications. It was found that +2 cobalt is easily oxidized in glacial acetic acid, but that the primary electrochemical oxidation product is probably +4 cobalt which is rapidly reduced by acetate to the stable +3 state. Cyclic voltammetry does not reveal separate +2 and +3 oxidation waves but does detect separate reduction waves for +4 and +3 cobalt. The +4/+3 cobalt wave appears to be much more reversible than the +3/+2 cobalt wave under these conditions. To facilitate large-scale electrochemical syntheses, a flow-through controlled potential electrolysis cell was designed for rapid electrolyses in solvents of high resistance. The efficiency of the completed cell was demonstrated in a massive oxidation of +2 manganese in glacial acetic acid in which the cell easily dissipated 400 watts of power while maintaining a solution temperature of less than 30°. In addition, during an electrolytic deposition of copper, it was found that the concentration of copper in the electrolysis solution decreased by ca 80% during a single pass through the cell of 15 seconds duration. (Diss. Abstr. Int., B)

5399 CALIFORNIUM. Keller, C. Bild Wiss.; 10: No. 4, 350-360(1973). (In German).

The historical background of the discovery of californium is described as well as its manifold applications and the current, mostly purpose-oriented production of this element, particularly ^{252}Cf in high-flux reactors. Californium-252 neutron sources are now more and more used in scientific and technical research work. Some of these applications, e.g. activation analysis, investigation of the seaground and the surface of planets, neutron irradiation in the medical field, are briefly outlined. (GE)

5400 MIXED LIGAND (DIISOBUTOXYPHOSPHATO-CHLORO) TITANIUM(III), URANIUM(IV) AND THORIUM(IV) COMPLEXES. Mikulski, C. M. (Drexel Univ., Philadelphia); Pytlewski, L. L.; Karayannis, N. M. J. Inorg. Nucl. Chem.; 35: No. 6, 2102-2104 (Jun 1973).

$TiCl_3$, UCl_4, or $ThCl_4$ reactions with triisobutyl phosphate (TIBP) at elevated temperatures, lead to the precipitation of mixed ligand complexes, involving coordination of both chloro and DIBP groups. Thus, UCl_4 and $ThCl_4$ yield chlorotris-(diisobutyoxyphosphato) M(IV) complexes and a mixture of isobutyl chloride, HCl and butene upon reaction with TIBP at 100 to 200°C. $TiCl_3$, on the other hand, reacts with TIBP under the same conditions to form dichloro (diisobutoxyphosphato) Ti(III) as final product. (UK)

5401 FAR INFRARED ABSORPTION SPECTRA OF RUBIDIUM URANIUM COMPLEX FLUORIDES. Soga, T.; Ohwada, K.; Iwasaki, M. (Japan Atomic Energy Research Inst., Tokai). J. Inorg. Nucl. Chem.; 35: No. 6, 2069-2074(Jun 1973).

The far infrared absorption spectra of rubidium uranium complex fluorides were measured in the frequency region from 500 to 30 cm^{-1}. Tentative assignments of the bands are proposed. Approximate force constants of the U–F stretching and the F–U–F bending are given. (UK)

5402 HYDROXYL AMMONIUM FLUORIDE-URANYL FLUORIDE COMPLEXES AND THEIR THERMAL DECOMPOSITION. Sahoo, B. (Indian Inst. of Tech., Kharagpur); Satpathy, K. C. J. Inorg. Nucl. Chem.; 35: No. 6, 2136-2137(Jun 1973).

The preparation of two hydroxyl ammonium fluoride–uranyl fluoride complexes, $(NH_3OH)_3(UO_2F_5)$ and $(NH_3OH)(UO_2F_3)$ is described. Thermal decomposition of the compounds were carried out in vacuo at about 400°C. During heating, simultaneous decomposition and reduction of uranium(VI) to uranium(IV) occurs and UF_4 and a mixture of UF_4 and UO_2F_2 are obtained from $(NH_3OH)_3$-(UO_2F_5) and $(NH_3OH)(UO_2F_3)$ respectively. The decomposition process of the hydroxyl ammonium fluoride uranyl fluoride complexes seems to be similar to the decomposition of hydrazinium fluoride uranyl fluoride complexes but contrast to the behavior of ammonium fluoride uranyl fluoride complex $(NH_4)_3(UO_2F_5)$ which undergoes simple dissociation and yields UO_2F_2 above 300°C. (UK)

5403 1,10-PHENANTHROLINE COMPLEXES OF SOME URANYL SALTS. Ahuja, I. S.; Singh, R. (Banaras Hindu Univ., India). J. Inorg. Nucl. Chem.; 35: No. 6, 2075-2078(Jun 1973).

Extensive studies were made on the coordination compounds formed by 1,10-phenanthroline with transition metal salts. Among the uranium(VI) complexes with this ligand only the uranyl nitrate–1,10-phenanthroline has been reported and its ir spectrum in the rock salt region studied. A description is given of the preparation and ir spectral features down to 200 cm^{-1} of the complexes formed by the interaction of 1,10-phenanthroline with uranyl chloride, sulphate and nitrate. (UK)

5404 NATURE OF AMMONIUM URANATES. Stuart, W. I.; Miller, D. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Inorg. Nucl. Chem.; 35: No. 6, 2109-2111(Jun 1973).

Samples of $UO_3 \cdot 2H_2O$ were reacted with various amounts of NH_4OH solution or NH_3 for at least 26 weeks. The resulting AU products were examined using ir spectrophotometry and x-ray diffraction techniques. From the evidence it is concluded that the AU system at equilibrium is a continuous nonstoichiometric system with zeolitic-type properties. This is as might be expected from the cation-exchange properties of $UO_3 \cdot 2H_2O$ (uranyl hydroxide hydrate) since ion exchange, by definition, implies nonstoichiometry. (UK)

5405 STABILITY CONSTANTS OF SOME ACTINIDE TROPOLONATE COMPLEXES. Magon, L.; Bismondo, A.; Bandoli, G.; Portanova, R. (Consiglio Nazionale delle Richerche, Padua). J. Inorg. Nucl. Chem.; 35: No. 6, 1995-2000(Jun 1973).

The tropolonate complexes of uranium(VI), neptunium(V) and plutonium(III) were investigated by means of potentiometric method in aqueous 1 M $NaClO_4$ solution at 20°C. For these complexes a strict dependence of the stability constants from the charge of the central ion, was observed. Further, the stability of these tropolonate complexes is compared to those of other actinide and lanthanide complexes. (auth)

Radioactive Waste Treatment

Refer also to abstracts 5225, 5308, 5524, 5545, and 6463.

5406 (AERE-M-2143) BITUMEN INCORPORATION: A.E.R.E. OPERATIONAL EXPERIENCES. Burns, R. H.; Clare, G. W. (Atomic Energy Research Establishment, Harwell (England)). Nov 1968. 36p. (CONF-681226-2). Dep. NTIS (U. S. Sales Only) $4.00.

From research coordination meeting on the incorporation of radioactive wastes in bitumen; Dubna, USSR (9 Dec 1968).

Operational experience of the Harwell bitumen plant, which was designed to incorporate radioactive chemical sludges and other suitable waste materials in bitumen as a means of insolubilization, is reported. The biggest problem of metering ferric hydroxide sludge has disappeared with the pelletization process using a rotary heated drum dryer. Comparative costing with other processes, in particular with cement, show that the bitumen process is economically viable. (DHM)

5407 (ANL-7972, pp 42-71) CONTROL OF GASEOUS AND PARTICULATE EFFLUENTS. Trevorrow, L.; Kullen, B.; Steindler, M. J. Dec 1972.

An estimation is presented of the production rates of tritium and noble gases in fuel reprocessing, allowing comparison of reprocessing procedures for fuels from LWRs, LMFBRs, and HTGRs. (DHM)

5408 (CEA-R-4444) COATING OF ALUMINUM RESIDUES CONTAINING FISSION PRODUCT FLUORIDES. Labe, P. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Apr 1973. 109p. (In French). Dep. NTIS (U.S. Sales Only) $7.50.

The treatment of high level wastes is studied in the case of the alumina beds coming from the reprocessing of irradiated fuel by fluoride volatility process. The tested method consists in coating the wastes with glass which results in dense blocks presenting many advantages compared with initial wastes, such as much safer manipulation and a reduced volume. Experiments were carried out to determine the volatility of different fission products fluorides and the convenient compositions of glass. (auth)

5409 (FRNC-CONF-33) RADIOACTIVE WASTE DECONTAMINATION. Blum, J. M.; Jaumier, J. J.; Verot, J. L. (Pechiney Ugine Kuhlmann, Paris (France)). 1972. 5p. (In French). (CONF-720454-2). Dep. NTIS (U. S. Sales Only) $3.00.

From meeting of the mineral section on problems posed by wastes arising from the processing of ores; Paris, France (19 Apr 1972).

A method of removing ^{106}Ru from effluents arising from irradiated fuel processing plants is presented. The effluent to be decontaminated is brought into contact with finely divided iron. After the treatment with Fe, the solution has a pH value of 6; the elimination of other ions present is then carried out (^{90}Sr, ^{144}Ce, ^{95}Zr, and ^{137}Cs). The experiment was effected on the laboratory scale at the CENC with a flow rate of between 1 and 2 l/h. An installation capable of handling between 20 and 80 l/h is currently being constructed. An inexpensive inorganic adsorbent (zeolite) is used to treat the water from the swimming pools in which irradiated fuels are stored. These two types of treatment enhance the quality of the decontamination and involve a relatively inexpensive overall cost. (FR)

5410 REVIEW OF TREATMENT TECHNIQUES. Van de Voorde, N. (Belgonucleaire, Mol, Belg.). pp 31-48 of Disposal of Radioactive Waste. Paris; Organization for Economic Co-Operation and Development (1972). (In French and English).

From meeting on disposal of radioactive waste; Paris, France (12 Apr 1972). See CONF-720453−.

Methods for the treatment of radioactive wastes are reviewed. The most efficient method for the treatment of radioactive wastes is determined by this physical state (solid, liquid, gaseous) and by the degree of radioactivity. Highly active liquid residues are usually concentrated by evaporation techniques and then stored. Less active liquid residues may be diluted or, according to the chemical composition, may be treated by coprecipitation, evaporation, or ion exchange techniques. Solid wastes of low and medium level activity are usually incorporated into concrete or bitumen. The choice of treatment for highly active solid wastes depends mainly on the type of storage decided. Gaseous radioactive effluents are treated by filtration, adsorption, extraction, or diffusion depending upon the radioisotopes present. (ERB)

5411 DEVELOPMENT OF RADIOISOTOPE PRODUCTS AND FISSION PRODUCTS. Kato, M. (Tokyo Univ.); Amano, H. Genshiryoku Kogyo; 18: No. 11, 24-28(Nov 1972). (In Japanese).

With the advance of nuclear power generation, the amount of radioactive wastes are ever increasing. If recovery and usage of radioisotopes in the wastes are realized on a large scale, additional value can improve the situation significantly. In this view, current development and steps to be taken in the future in Japan are described: utilization of the RIs in the world including Japan for RI electric generators, recovery of noble metals, and large radiation sources; current technology of fission product recovery including that of Japan; and measures to be taken in Japan for the recovery of transuranium elements and the FPs, including the relation with waste disposal elucidation of installation of a pilot plant for the purpose, formation of collective system for development and utilization, and international cooperation. (Japan)

5412 WEATHERING OF IMPREGNATED CHARCOALS USED IN REACTOR FILTER SYSTEMS. Ikezawa, Y. (Japan Atomic Energy Research Inst., Tokai); Yoshida, Y.; Kitani, S.; Kozuka, M. Kuki Seijo; 10: No. 2, 71-78(Jun 1972). (In Japanese).

The effects of weathering of four kinds of impregnated charcoal (MSA-85851, BC-727, SnI_2-impregnated, KSCN-impregnated) on the efficiency of trapping CH_3I was investigated in air flow or by the static adsorption of NO, NO_2 and SO_2. After the weathering for 30 or 120 days in air flow, charcoal layers close to the inlet of air showed a decrease in efficiency. When moisture was eliminated from the air, however, no measurable effect was observed. No poisonous substance was found in the gas released from the charcoal by heat-treatment. It is considered that impurities in the air are adsorbed and react with the moisture, thus acid is formed and surface property of the charcoal is affected. SO_2 and NO_2 also showed unfavorable effects on the efficiency of the charcoal in the presence of the moisture. NO showed little effect. As the effect of the weathering in the air was larger than that in the atmosphere of SO_2 or NO_2, effect of other impurity gases such as O_3 or CH_4 is suggested. (JA)

5413 SOLIDIFICATION TREATMENT OF RADIOACTIVE WASTES IN NUCLEAR POWER PLANTS. Nagakura, T. (Central Research Inst. of Electric Power Industry, Chiba, Japan). Konkurito Janaru; 10: No. 6, 93-99(Jun 1972). (In Japanese).

Treatment of radioactive wastes is closely related to the method of their disposal. Important processes in the treatment are separation of concentrated wastes from dilute ones and their solidification for disposal. When a method of solidifying wastes is selected, many conditions must be taken into account which are required of the solidifying process and solidified materials. Several methods seem to be promising, especially cement-solidification and asphalt-solidification methods. The solidified wastes are disposed underground in some countries, in the ocean in others, and other countries have not decided on a method of disposal. The cement-solidification method is employed in nuclear power plants in Japan now. Many experimental investigations have been carried out in order to increase the strength of the solidified materials. (Japan)

5414 WASTE-GAS PROCESSING SYSTEM FOR THE TREATMENT OF RADIOACTIVE FISSION AND ACTIVATION GASES. Queiser, H.; Schwarz, H. (to Licentia Patent-Verwaltungs GmbH). German Patent 2,133,250. 18 Jan 1973. 17p. (In German).

A two-stage waste-gas processing system is described with a mechanical and an adsorptive delay line for the treatment of radioactive waste gases. The adsorptive delay line acts simultaneously as the mechanical delay line for the gas mixture by fixation of the ratio of the gap volume between the packing material of the adsorbent to the total volume of the adsorbent. (GE)

5415 FEASIBILITY OF USING ALGAE IN A PROCESS FOR TREATING RADIOACTIVE WASTES. Denovan, J. T. Ann Arbor, MI; Univ. of Michigan (1972). 97p. University Microfilms Order No. 73-11,088.

Thesis (Ph. D.).

The purpose of this investigation was to determine the feasibility of using algae in a process for treating radioactive wastes. In order to determine the feasibility of such a process, it was necessary to measure the influence of certain parameters on the accumulation of radionuclides by algae. The parameters studied were competing ion concentration, hydrogen ion concentration, chelating agent concentration, and algal growth phase. Laboratory cultures of Chlorella pyrenoidosa were grown under continuous culture conditions and the accumulation of Cs-137, Sr-85, Zn-65, and Co-60 by the algae was measured. Competing ions influenced the accumulation of radionuclides by C. pyrenoidosa. Potassium ion concentrations below 15 mg/l reduced the growth of C. pyrenoidosa and increased the accumulation of Cs-137. The removal efficiencies obtained for Cs-137 ranged between 88 and 83% for potassium concentrations between 2 and 15 mg/l but were reduced to below 20% when the potassium ion concentration was greater than 15 mg/l or less than 2 mg/l. Stable cesium depressed the accumulation of Cs-137. Eighty-seven percent of the added Cs-137 was removed at a stable cesium concentration of 10^{-13} g/ml while only 25% was removed when the stable cesium concentration was increased to 10^{-5} g/ml. The accumulation of the radionuclides was independent of hydrogen ion concentration over the range of pH values studied (5.0 to 8.0). The growth of the algae was influenced by pH, however. The optimum pH for growth, measured as maximum cell concentrations obtained, was 6.0. The concentration of the chelating agent, EDTA, influenced the accumulation of Zn-65, Cs-137, and Co-60 by C. pyrenoidosa, but not the accumulation of Sr-85. The removal of Cs-137 increased with increasing EDTA concentrations, and the removal of Zn-65 and Co-60 was increased as EDTA concentrations were decreased. Data collected from this investigation showed that removal efficiencies were maximum for C. pyrenoidosa maintained in the late exponential or early stationary phases of growth. During the early and middle exponential phases of growth removal efficiencies were lower than in later stages of growth. It is concluded from this study that the use of algae to treat radioactive wastes would be feasible under certain situations. It is recommended that an algal treatment process be utilized as a support system to existing treatment processes such as evaporators and ion exchangers. The use of algae for the treatment of radioactive wastes appears to be most applicable in situations where the organisms grow abundantly in existing structures within the boundaries of nuclear facilities. Areas where algae and other freshwater plants grow abundantly and may even become a nuisance are cooling towers, lagoons, and discharge canals. (Diss. Abstr. Int., B)

5416 DECONTAMINATION OF RADIOACTIVE LIQUID EFFLUENTS. Kieschnick, E. (Technische Rundschau Sulzer, Winterthur, Switzerland). Tech. Rundsch. Sulzer; 53: No. 4, 227-235(1971).

To reduce and eliminate radioactive substances in circulating and waste water, use is made of decontamination installations. A review is given of the main methods of decontamination and the necessary safety measures. (Occup. Saf. Health Abstr.)

Radioisotope Production

Refer also to abstracts 6491 and 6492.

5417 (CONF-730602-1) CURIUM-244 ISOTOPIC POWER FUEL: CHEMICAL RECOVERY FROM COMMERCIAL POWER REACTOR FUELS. Posey, J. C. (Oak Ridge National Lab., Tenn.). 1973. 35p. Dep. NTIS $3.75.

From 75th national AIChE meeting; Detroit, Michigan, USA (3 Jun 1973).

The properties of $^{244}Cm_2O_3$ make it attractive as a radioisotopic power source material for any of several types of electrical power generators. Curium is present in wastes resulting from the reprocessing of the irradiated fuel of nuclear power reactors. Consequently, a large potential supply will be available in future years. Estimates indicate that its cost will be substantially lower than that of ^{238}Pu. A proposed process for curium recovery based on existing technology is outlined. A fraction containing the lanthanides and trivalent actinides is prepared using differential solvent extraction. Since this method of extraction is not widely known, it is described in some detail. The curium is separated from the lanthanides by a high pressure ion-exchange system. (auth)

5418 (ICP-1023) 1972 OPERATION OF THE ICPP RARE GAS RECOVERY FACILITY. Bendixsen, C. L.; German, F. O.; Hammer, R. R. (Allied Chemical Corp., Idaho Falls, Idaho. Idaho Chemical Programs Operations Office). Mar 1973. Contract AT(10-1)-1375. 24p. Dep. NTIS $4.00.

Operation of the Rare Gas Recovery Facility at the Idaho Chemical Processing Plant during FY 1972 resulted in the recovery of 9200 curies of ^{85}Kr and 600 liters of xenon from off-gas produced during dissolution of spent nuclear fuel elements. Overall recovery efficiencies for krypton and xenon were 44% and 49%, respectively. Operation of a cryogenic distillation process with the potential efficiency of greater than 97% for krypton recovery was demonstrated. (auth)

5419 CURRENT RADIOISOTOPE DEMANDS IN JAPAN. Yamagami, T.; Ichiyanagi, K. (Japan Atomic Energy Research Inst., Tokyo). Genshiryoku Kogyo; 18: No. 11, 9-13; 19(Nov 1972). (In Japanese).

Demand for radioisotopes in Japan is increasing year by year, and about 90% of the total sales is handled by the Japan Isotope Association. Usage of the radioisotopes is predominantly as secondary products such as medical supplies, radiation sources and labeled compounds and only in small part as primary purified ones. In the secondary products, the portion manufactured in Japan exceeds that by import; on the other hand, the primary isotopes are mostly imported. Situation of the RI demand in Japan is described with respect to the following: distribution mode and amount, marketing structure, demand of individual RI species, future of the RI demand, pricing mechanism, and future prospect of price. (Japan)

5420 PREPARATION OF RADIOISOTOPES IN THE UPI (URAL POLYTECHNIC INSTITUTE) CYCLOTRON. Gavrilov, F. F.; Dvinyaninov, B. L.; Zhukovskaya, A. S.; Ushakov, Yu. A; Khrustal'kov, G. V.; Shtol'ts, A. K. (Ural Polytechnic Inst., USSR). Tr. Ural. Politekh. Inst.; No. 189, 33-37(1971). (In Russian).

Methods of preparation of ^{22}Na, ^{48}V, ^{52}Mn, and ^{57}Co are presented. The deuteron energy was 12.5 to 13 MeV on a rotating target, internally water-cooled. Parameters for the cyclotron and methods of separation of the pure isotopes are included. (DHM)

5421 PREPARATION OF AN INDIUM-113m STERILE GENERATOR. Moszynska, K. (Inst. of Nuclear Research, Swierk, Poland); Deptula, C. Nukleonika; 18: No. 1, 35-44(1973). (In Polish).

The preparation of zirconium oxide hydrate and investigations of its sorption properties for ^{113}Sn and ^{113m}In as a function of the precipitation and drying temperature of this oxide are described. Sterile generators of $^{113}Sn/^{113m}In$ were prepared. The elution efficiency of ^{113m}In, its radiochemical purity, and the amount of zirconium in the eluate were determined. (auth)

5422 APPLICATION OF THE CYCLOTRON TO THE PRODUCTION OF RADIONUCLIDES. Roehm, H. F.; Muenzel, H. (Kernforschungszentrum, Karlsruhe, Ger.). (1972). vp. (In German).

From meeting: nuclear medicine and radiochemistry; Freiburg i. B., Germany (27 Sep 1972).

In order to obtain a certain radionuclide with high activity by means of cyclotron irradiation the kind and energy of the projectiles as well as the kind of target have to be chosen so that disturbances by unwanted nuclear reactions are kept as low as possible. The knowledge of the excitation function of the desired reaction is important for evaluating the produced activity. A method is presented with the help of which unknown excitation functions can be determined and the activity yields of nuclides which are produced in thick targets can be calculated. The production of ^{68}Ge is described as an example whose daughter product is ^{68}Ga, a nuclide which is used in diagnostic medicine. (GE)

5423 RADIOPOTASSIUM-38 FOR IN VIVO STUDIES OF DYNAMIC PROCESSES. Myers, W. G. (Ohio State Univ. Hospital, Columbus). J. Nucl. Med.; 14: No. 6, 359-360(Jun 1973).

Rapid uptake of ^{42}K by the myocardium indicates that 7.7-min ^{38}K may be advantageous over 22.4-hr ^{43}K for in vivo imaging. The two 511-keV "annihilation" photons, which are emitted at 180 deg to each other incidental to the decay of ^{38}K by positron emission, furnish inherent directionality and high sensitivity when they interact with appropriate detectors. The 2.17-MeV gamma ray emitted in each disintegration usually is disadvantageous. The 11-min average life of ^{38}K ideally matches the duration of processes involving rapid turnover of potassium. And it provides greatly reduced radiation exposures, improved statistics, and frequent repeatability in obtaining multiple views and in studies of pathological, physiological, and pharmacological variations. Bombardment of calcium carbide with deuterons from a small biomedical cyclotron, followed by simple and rapid chemical manipulations, furnishes ^{38}K in high specific activity in the $^{40}_{20}$Ca($^{1}_{1}$H, $^{4}_{2}$He)$^{38}_{19}$K nuclear reaction. (auth)

5424 METHOD FOR RAPID SEPARATION OF THE SHORT-LIVED ISOTOPES OF OSMIUM AND THE RHENIUM DAUGHTER. Vaishnis, P. P.; Ignatenko, E. I.; Konev, V. G.; Sergeev, Yu. Ya. (Inst. of Nuclear Physics, Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 126(Jan 1973). (In Russian).

A technique is described for the fast separation of short-lived Os isotopes obtained during the irradiation of mercury nitrate with 1-GeV protons. A saturated solution of the target material is heated in a Wurtz flask to 90 to 100°C through which air is passed. The apparatus is placed in the proton beam, and the Os vapor is carried by the air stream to a plastic support, thereby reducing the separation time to 10 to 15 seconds. (KSW)

5425 NUCLEAR INSTRUMENTATION FOR CURIUM AND CALIFORNIUM PROCESSING. Herold, T. R. (E. I. du Pont de Nemours and Co., Aiken, SC). IEEE (Inst. Elec. Electron. Eng.). Trans. Nucl. Sci.; NS-20: No. 1, 232-241(Feb 1973).

Several new instruments for process control, laboratory analyses, and product assay and inventory were developed for the ^{244}Cm and ^{252}Cf production programs at SRP. Alpha activities between 10^6 and 10^{13} dpm and neutron activities up to 10^{11} n/sec are monitored, picogram amounts of ^{252}Cf and nanogram amounts of ^{244}Cm are determined routinely, and precision assays of up to 100-mg quantities of ^{252}Cf product are quickly made. (auth)

5426 RESIDUE ADSORPTION. 5. Separation of RaD (^{210}Pb) from RaE (^{210}Bi) and RaF (^{210}Po). Kirby, H. W. (Monsanto Research Corp., Miamisburg, OH). J. Inorg. Nucl. Chem.; 35: No. 6, 2043-2047(Jun 1973).

Radium D (^{210}Pb) can be decontaminated of one or both of its decay products by drying on a platinum surface followed by selective desorption with an appropriate solvent. Neutral desorbents, such as 0.1N NH_4Cl leave the RaE (^{210}Bi) and RaF (^{210}Po) behind while desorbing the RaD (^{210}Pb); acid desorbents remove both the RaE and RaD while leaving the RaF still adsorbed. The adsorption of ^{210}Po on platinum is unique in that no significant fraction of the ^{210}Po could be desorbed from an ignited platinum surface by any concentration of HCl up to 6N. In this respect platinum differs from glass, gold, tantalum and iridium, on which the adsorption appears to be chiefly physical in nature. It is suggested that ^{210}Po is reduced to the metal by the platinum surface. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts 5541, 5554, and 7295.

5427 (ANL-7972) CHEMICAL ENGINEERING DIVISION FUEL CYCLE TECHNOLOGY QUARTERLY REPORT, JULY–SEPTEMBER 1972. Webster, D. S.; Jonke, A. A.; Levitz, N. M.; Miller, W. E.; Steindler, M. J.; Vogel, R. C. (Argonne National Lab., Ill). Dec 1972. Contract W-31-109-eng-38. 75p. Dep. NTIS $3.00.

Separate abstracts were prepared for each of the four sections presented. (DHM)

For abstracts of individual sections see: 5186, 5363, 5407, and 5428.

5428 (ANL-7972, pp 13-30) LIQUID METAL DECLADDING OF REACTOR FUELS. Jonke, A. A.; Miller, W. E. Dec 1972.

Progress is reported on experiments to determined procedures and operating conditions whereby U and Pu dissolved in Zn–Mg–Ca solvent can be precipitated as nitrides and recovered for subsequent processing in a Purex head-end; study of the kinetics of the nitriding reactions; study of heat generation in the solvents for the proposed pyrochemical head-end process; evaluation of materials of construction for crucibles to be used in pyrochemical processing; and study of decontamination of uranium from iodine. (DHM)

5429 (ARH-SA-159) RE-USE OF AQUEOUS WASTES IN HANFORD CHEMICAL PROCESSING FACILITIES. Hanson, G. L. (Atlantic Richfield Hanford Co., Richland, Wash.). 30 Mar 1973. Contract AT(45-1)-2130. 24p. (CONF-730433-1). Dep. NTIS $3.25.

From national conference on complete water use; Washington, District of Columbia, USA (23 Apr 1973).

Modifications to nuclear fuels reprocessing facilities, process flowsheets, and equipment, have permitted re-use of waste waters and recovery and re-use of waste chemicals at Hanford. Improved process performance, reduced operating costs, and decreased waste volumes for storage or for safe discharge to the environment have resulted. Although these modifications were implemented for nuclear fuels reprocessing facilities, other industry may have similar opportunities in their operations. (auth)

5430 (DOCKET-50201-139) WEST VALLEY REPROCESSING PLANT. Approach to Accident Analyses. (Nuclear Fuel Services, Inc., Rockville, Md.). 7 Dec 1972. 2p. Dep. NTIS $3.00.

5431 (DOCKET-50201-140) WEST VALLEY REPROCESSING PLANT. Head End Ventilation System Performance Report, July 1–December 31, 1972. (Nuclear Fuel Services, Inc., West Valley, N.Y.). Mar 1973. 4p. Dep. NTIS $3.00.

5432 (DOCKET-50268–44) MIDWEST FUEL RECOVERY PLANT. Amendment 34, Response to AEC Questions. (General Electric Co., San Jose, Calif. Nuclear Energy Div.). 26 Mar 1973. 12p. (NEDO–10178–15). Dep. NTIS $3.00.

Responses to AEC questions concerning preoperational tests at Midwest Fuel Recovery Plant are presented that consider balancing of building ventilation system and surveillance of ground water flows and leakage from and intrusion into underground vaults and basins. (DHM)

5433 (KFK-1788) PROJECT ACTINIDES: SECOND SEMI-ANNUAL REPORT, 1972. (Kernforschungszentrum, Karlsruhe (West Germany)). Mar 1973. 103p. (In German). Dep. NTIS (U.S. Sales Only) $7.25.

This second semiannual report for 1972 describes the results of activities of the Actinide Project performed by institutes and departments of the GfK. The following subjects investigated within the framework of the project are treated: behavior of Am and Cm in acidic process solutions in the reprocessing of nuclear fuels and their separation; development of cermets as well as of Am–Al alloys and their irradiation behavior; chemical recovery of irradiated transuranium elements; process facilities; development and application of neutron and radiation sources; development and usage of borehole and trail probes. (auth)

5434 (ORNL-TM–4141) AQUEOUS FUEL REPROCESSING QUARTERLY REPORT FOR PERIOD ENDING DECEMBER 31, 1972. Unger, W. E.; Blanco, R. E.; Crouse, D. J.; Irvine, A. R.; Watson, C. D. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 58p. AT $5.45.

Research progress is reported on aqueous reprocessing of LMFBR fuels in the following areas: shipping, head-end processing, volatile fission product removal, iodine control, dissolutions of LMFBR fuels, and off-gas treatment. (DHM)

5435 (RT/ING–(72)13) GUIDE TO KNOWLEDGE OF ITREC AND THE PCUT PROGRAM. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 17 Jul 1972. 124p. (In Italian). Dep. NTIS (U. S. Sales Only) $8.25.

Conclusions from a ten year period in the frame of the PCUT program are: The site of Trisaia appears to be particularly qualified from the point of view of the nuclear installation; the ITREC plant is an adequate instrument to test the processing of fuels with incomplete decontamination and remote refabrication; and particular emphasis has been put with regard to fuel cycle in heavy water reactors and in HTR's. (auth)

5436 REPROCESSING OF NUCLEAR REACTOR OXIDE FUELS. Wurm, J. G. (to Commission of the European Communities). German Patent 1,467,322. 18 Jan 1973. 4p. (In German).

A method for the reprocessing of oxide nuclear reactor fuels is described in which UO_2 in basic fused alkali compounds is converted to alkali uranate in the presence of oxidizing agents. The released fission gases as well as parts of the fuel element cladding are removed from the melt. Finally the precipitated alkali uranate in powder form is separated from the fluid melt. The filtrate containing the soluble fission products as well as other elements originating from the fuel matrix, such as molybdenum or niobium, is transformed into a solid water-insoluble cement-like mass containing Al_2O_3, SiO_2 and other oxide-contained additions. (GE)

ENGINEERING

Energy Conversion

Refer also to abstracts 7148, 7616, and 7623.

5437 (AD-755203) CALCULATION OF NONSTEADY FLOW IN THE LINEAR MHD GENERATOR. Final Report. Rosciszewski, J. J.; Yeh, T. T. (Air Vehicle Corp., San Diego, Calif.). Dec 1972. Contract N00014-72-C-0019. 55p. NTIS.

The following is discussed: shock tube flow passing through a section of a linear MHD generator; and establishment of quasi-steady conditions in a blow-down nonequilibrium MHD generator. (NTIS)

5438 (AD-755955) BASIC RESEARCH IN THERMIONIC ENERGY CONVERSION. Final Technical Summary Report, 1 December 1971–30 November 1972. Hansen, Lorin K.; Warner, C. (Atomics International, Canoga Park, Calif.). Jan 1973. 177p. NTIS.

The report presents some of the results of the past year's work in a study of thermionic converters. It is a study of the basic processes in thermionic diodes, and the application of this basic information to the achievement of practical thermionic energy conversion. The studies presented are: simplified thermionic converter calculations; research converter operation; density of ions in a double sheath trap; the W-O system; The W(100)-O-C's system. (auth)

5439 (ORNL-TM-4009) ISOTOPE KILOWATT PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 30, 1972. (Oak Ridge National Lab., Tenn.). Feb 1973. Contract W-7405-eng-26. 18p. Dep. NTIS.

Work in progress on developing a 1 to 10 kW radioisotope-fueled energy conversion system for terrestrial and undersea use is described. Information is included on: evaluation of organic fluid for organic Rankine cycle conversion system; performance testing of thermoelectric module; thermal conductivity testing of the ¼-scale aluminum insulation specimen; design of test equipment for full-scale fusible insulation evaluation test; and fabrication of nonradioactive dummy fuel pellets and dummy capsules. (LCL)

5440 (ORNL-TM-4129) ISOTOPE KILOWATT PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1972. Fraas, A. P.; Samuels, G. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 25p. Dep. NTIS $3.25.

Work in progress on developing a 1 to 10 kW radioisotope-fueled energy conversion system for terrestrial and undersea use is described. Information is included on: equipment for and results from decomposition testing of Dowtherm which is being evaluated as a working fluid for an organic Rankine cycle conversion system; fabrication and installation of equipment for testing heat pipes; thermal conductivity testing of the ¼-scale aluminum insulation specimen; fabrication and testing of equipment for full-scale fusible insulation evaluation tests; and welding and loading of dummy fuel capsules for acceptance tests. (LCL)

5441 (UCID–16112) LOSSES DUE TO IONIZATION AND CHARGE EXCHANGE IN THE CHANNEL OF THE DIRECT CONVERTER. Barr, W. L. (California Univ., Livermore. Lawrence Livermore Lab.). 30 Aug 1972. Contract W-7405-eng-48. 9p. Dep. NTIS $3.00.

Gas molecules in the direct converter may be ionized by or undergo charge-exchange with ions in the incident beam. The resultant cold ions and electrons will be accelerated by the electric field and will carry away electrical energy. To evaluate the loss due to these effects, trajectories were calculated for cold ions and cold electrons started at uniformly spaced points in the chemical regions at two different axial locations. The calculations show that at 1×10^{-5} torr D_2 in the channel, there is a 4.3% drop in the efficiency of energy recovery when $c = 3.0$ and the secondary electron emission coefficient $\epsilon = 3$. The main loss mechanism is via secondary electrons which are produced when ions strike the grids. If $\epsilon = 2$, the drop in efficiency is 3.3%. The loss scales directly with pressure. When $c = 2.5$, the losses are reduced because the differences in potential are reduced. In that case, the loss of efficiency is 3.6% when $\epsilon = 3$ and 2.8% when $\epsilon = 2$. (TFD)

5442 (WANL-PR-953074-14) STUDY OF THE COLLECTOR/HEAT PIPE COOLED EXTERNALLY CONFIGURED THERMIONIC DIODE. Final Report. (Westinghouse Electric Corp., Pittsburgh, PA. Astronuclear Lab.). 6 Mar 1973. 83p. Dep NTIS $6.25. For Jet Propulsion Lab., Pasadena, Calif.

A collector/heat pipe cooled, externally configured (heated) thermionic diode module was designed for use in a laboratory test to demonstrate the applicability of this concept as the fuel element/converter module of an in-core thermionic electric power source. During the course of the program, this module evolved from a simple experimental mock-up into an advanced unit which was more reactor prototypical. Detailed analysis of all diode components led to their engineering design, fabrication, and assembly, with the exception of the collector/heat pipe. While several designs of high power annular wicked heat pipes were fabricated and tested, each exhibited unexpected performance difficulties. It was concluded that the basic cause of these problems was the formation of "crud" which interfered with the liquid flow in the annular passage of the evaporator region. LASL experience indicated that crud buildup is especially severe when stainless steel is used as the heat pipe structural material and that the deleterious effects of this crud are most pronounced in heat pipes having small annular liquid flow passages. The design approach followed and the results of the analysis leading up to the reference thermionic module designs, both "initial" and revised (or "final") are described. Engineering layout drawings for components of both modules are given. The various steps taken in the component fabrication and the module assembly are detailed. While the testing and experimental portions of the program were not completed, the report describes the items in these areas that were accomplished. Since the collector/heat pipe development played so important a role in this program, the analysis, design, development, fabrication and testing of these annular heat pipes are separately treated. While these efforts did not produce a heat pipe that could successfully transfer the large heat flux required for the postulated in-core thermionic reactor application, it is believed that the information obtained from this study could contribute towards the development of a high-performance heat pipe. (auth)

5443 IMPROVEMENTS IN OR RELATING TO THERMOELECTRIC UNITS. Penn, A. W.; Neighbour, F. (to United Kingdom Atomic Energy Authority). British Patent 1,303,834. 24 Jan 1973. Filed date 30 Jan 1970. 6p.

A thermoelectric unit is described having a number of elements of Bi telluride-based semiconductor material, alternately of P- and N- type. The elements are connected together to form a series of thermocouples by conducting bridges extending across the ends of pairs of elements; the bridges comprise Au deposited by vacuum evaporation on to the elements. The unit may be incorporated in a thermoelectric battery for a cardiac pacemaker. The method of manufacture is described. (UK)

5444 MHD GENERATOR. Barbacsy, L.; Mueck, G.; Mehnert, W.; Plantikov, U. (to Messerschmitt Boelkow Blohm GmbH). German Patent 1,964,265. 24 Jun 1971. Filed date 22 Dec 1969.

A MHD generator for supplying electric energy, especially on board airplanes or space vehicles, is described. A gas, vapor, or liquid is placed in rotation by a propulsion agent within a magnetic field in a whirlpool chamber. (TSS)

5445 CONVECTIVE HEAT LOSS AND ELECTRICAL CONDUCTIVITY IN MHD CHANNEL. Brandus, L. (Inst. of Physics, Bucharest). Rev. Roum. Phys.; 18: No. 2, 208-210(1973).

The convective heat loss is considered for an MHD channel of constant velocity. The calculation of the electrical conductivity based on collision cross-sections is also considered. (auth)

5446 COMPARATIVE STUDY ON TWO TYPES OF SILICON p-n JUNCTION FOR PHOTOVOLTAIC AND ELECTRONVOLTAIC CELLS. Lee, H. Y.; Lee, W. K. (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 5: No. 1, 13-19(Mar 1973).

Photovoltaic and electronvoltaic cells were obtained by forming Sb-implanted n- on p-type and In-implanted p- on n-type silicon p-n junctions. Such shallow implantations into silicon wafers due to each dopant were done by the VDH-Implanter (VDH = Vacuum Discharge and Heating). The two types of the silicon p-n junction for these cells showed special features on their various characteristics to be fitted for the direct energy conversions. Results of a comparative study of both of these cells are described. (auth)

5447 STATE AND PROSPECTS OF THE DIRECT ENERGY CONVERSION. Part 2. Justi, E. W. (Technische Univ., Brunswick). Phys. Bl.; 29: No. 2, 71-79(1973). (In German).

The direct conversion of chemical into electrical energy is described, e.g., high temperature fuel cells, medium temperature cells, and environment temperature cells. (GE)

5448 PROPOSED NEW CONCEPT FOR A SOLAR-ENERGY CONVERTER. Bailey, R. L. J. Eng. Power; 94: No. 2, 73-77 (Apr 1972).

Results of some preliminary new research exploring the possibilities of creating high efficiency solar-electricity converters utilizing wavelike properties of radiation interacting with absorber-converter elements are presented. The concept is believed to be a new, unique, and potentially useful pyramidical solar radiation absorber-converter structure. It is based on the possibility of extending concepts of power absorbing antennas and converters to the visible light range. The resulting proposed converter structure would have a rough surface texture and yield a dc output. It may have, if subsequently researched, significant efficiency, cost, and fabricating advantages, particularly for large-scale terrestrial utilization of solar energy. The concept is called an Electromagnetic Wave Energy Converter. Concept validity evidences of a preliminary kind at both microwave and near light wavelengths are presented. (App. Mech. Rev.)

5449 ALL BONDED THERMIONIC ENERGY CONVERTER. Hobson, R. R.; Dunlay, J. B. (to United States Atomic Energy Commission). U. S. Patent 3,727,083. 10 Apr 1973. Filed date 1 Sep 1970. 6p.

A thermionic fuel element for electrical power generation having an all bonded sheath-sheath insulator collector assembly is described. The assembly is provided with at least one internal groove by which an emitter intercell sub-assembly is bonded to the first-mentioned assembly. The subassembly is constructed to provide the required electric interconnections between a series of interconnected collector-emitter units or cells as well as providing passageways for an alkali metal vapor located in an interelectrode space, while providing proper spacing between the collector and emitter units thereof. In addition each sub-assembly includes means which readily allow the sub-assembly to be inserted, aligned and secured to the first-mentioned assembly while supporting the emitter, maintaining the emitter to collector gap, and providing a heat transfer path to the first-mentioned assembly. (Official Gazette)

5450 THEORETICAL STUDY OF INSTABILITY IN NON-EQUILIBRIUM MAGNETOHYDRODYNAMIC PLASMAS. Coakley, J. F. Chicago; Illinois Inst. of Tech. (1972). 169p. University Microfilms Order No. 73-12,201.

Thesis (Ph. D.).

The stability of a seeded inert gas plasma is considered in a theoretical analysis. Such plasma is of interest for use in closed cycle magnetohydrodynamic power generators due to the non-equilibrium ionization which results in increased electron temperature and, thus, improved performance. Recent experimental work has identified two nonuniform structures which can adversely influence the performance of a generator. The reduced performance due to nonuniformities in the bulk of the flow is attributed to large-scale inhomogeneities of the streamer-type and to smaller scale striations which result from the electrothermal or ionization instability. To study these phenomena a linearized combined-wave analysis is considered including the electrothermal, thermal and magnetoacoustic wave modes along with the electromagnetic wave mode. The latter wave mode is due to the fluctuations of the magnetic field and is found to be of importance for longer wavelength disturbances. The analysis includes the effects of radiation, electron heat conduction and convection as well as Coulomb collisions and neutral collisions. The linear theory predicts adequately the phase velocity and orientation of the smaller scale striation. However, a dominant streamer pattern does not emerge. Accordingly, an energy analysis of the streamer is considered. This appears to reasonably describe the streamer pattern. The streamer analysis establishes an upper limit on the size of striations that can develop and also predicts the experimentally observed constriction of the streamer with increasing Hall parameter. Comparisons between experimental, empirical and theoretical results indicate generally good agreement. (Diss. Abstr. Int., B)

Facilities and Equipment

Refer also to abstracts 5585, 6247, and 7668.

5451 (CONF-710355-1) TODAY'S ACHIEVEMENTS WITH CONVENTIONAL CLOSED CYCLE GAS TURBINES AND THEIR FUTURE ASPECTS IN THE NUCLEAR FIELD. Taygun, F.; Schmidt, D. (Brown Boveri-Sulzer Turbomachinery Ltd., Zurich (Switzerland)). [nd]. 20p.

From 16th annual international gas turbine conference; Houston, Texas, USA (28 Mar 1971).

Experience gained with conventional closed-cycle gas turbines in industrial and municipal operation shows that such plants are reliable. This led gradually to larger unit outputs. The largest conventional plant of this type for combined power and heat production, the Spittelau plant, is now under construction in Vienna. The fundamental similarity of air and helium cycles and the good results obtained with conventional plants provide the basis for the further development of closed-cycle plants for the nuclear energy field for units up to 1200 MW(e) in one set coupled in a direct-cycle with a gas-cooled high-temperature reactor. A single loop, single shaft 600 MW(e) helium turbine is now under development. (auth)

5452 (DOCKET-701292-5) FUELS FABRICATION PLANT. Preconstruction Submittal. (Directorate of Licensing (AEC), Washington, D. C.). 12 Jan 1973. 13p. Dep. NTIS $3.00.

Comments and questions are submitted on the revised preconstruction submission for the NFS Fuel Fabrication Plant to be built at the Western New York Nuclear Services Center. (RCK)

5453 (DUN-8099) PROCEDURE FOR CONTROLLING THE PRESSURES USED ON EXTRUSION PRESS TOOLING. (Douglas United Nuclear, Inc., Richland, Wash.). 12 Jan 1973. 5p. Dep. NTIS $3.00.

A procedure is described which establishes and assures conformance to certain maximum allowable pressures which may be exerted on extrusion press tooling. These pressure limits are required for personnel safety and for preventing damage to extrusion equipment since the extrusion press is capable of exerting forces greater than the extrusion tooling can withstand. Instructions are given for determining the maximum allowable extrusion pressure for each extrusion stem used and for adjusting the hydraulic system pressure relief valves to assure that the maximum pressure is not exceeded during extrusion operations. The responsibilities of personnel during the extrusion operations are itemized. (LCL)

5454 (GAT-Z-4128(Vol.2)) EXPERIMENTAL INVESTIGATION OF AIR RECIRCULATION CHARACTERISTICS OF AIR COOLED CONDENSER ARRAYS ON A PROCESS BUILDING. Report EERL TR-105. Hoydysh, W. G.; Strom, G. H.; Cirillo, R. R. (New York Univ., N. Y. (USA). Dept. of Aeronautics and Astronautics). Jul 1971. Contract AT(33-2)-1. 143p. Dep. NTIS $5.45.

For Goodyear Atomic Corp., Piketon, OH.

Test data from experiments on the velocity and quantity of air recirculated in the air-cooled condenser arrays of a process building are tabulated. (LCL)

5455 (LA-5204-MS) SUBTERRENE PENETRATION RATE: MELTING POWER RELATIONSHIP. Gido, R. G. (Los Alamos Scientific Lab., N. Mex.). Mar 1973. Contract W-7405-eng-36. 12p. Dep. NTIS $3.00.

The Subterrene method of tunneling and excavating melts rock in sufficient quantities so that the melt can be manipulated to provide a glass-cased borehole or tunnel. A key factor in evaluating such a system is penetration rate. Field test and laboratory data are used to verify that penetration rate is directly proportional to melting power, as anticipated on the basis of the physical principles involved. The field tests resulted in holes up to 25 m deep. The melting power is related to total heater power via system power inefficiency factors which account for heat losses to the ambient rock to the structural coolant. (auth)

5456 (LA-5205-MS) DESIGN AND DEVELOPMENT OF PROTOTYPE UNIVERSAL EXTRUDING SUBTERRENE PENETRATORS. Neudecker, J. W.; Giger, A. J.; Armstrong, P. E. (Los Alamos Scientific Lab., N. Mex.). Mar 1973. Contract W-7405-eng-36. 19p. Dep. NTIS $3.00.

The design features and development tests of electrically heated rock-melting universal extruding SUBTERRENE prototype penetrators are described. Engineering drawings of the successful 58-mm-(2.3-in.)-dia refractory metal penetrator system are presented. These prototype penetrators have melted holes in laboratory samples of basalt, granite, and low-density tuff. The rock-melt debris, or cuttings, can be extruded in a variety of forms including glass rods, glass pellets, and rock wool. These cuttings are removed by the coolant through the annular stem in a manner similar to that used in rotary drilling technology. (auth)

5457 (LA-5206-MS) IDENTIFICATION OF POTENTIAL APPLICATIONS FOR ROCK-MELTING SUBTERRENES. Sims, D. L. (Los Alamos Scientific Lab., N. Mex.). Feb 1973. Contract W-7405-eng-36. 17p. Dep. NTIS $3.00.

Radically new tunneling and excavating devices based upon rock-melting may offer enhanced advance rates at significantly reduced cost. Potential applications have been investigated to determine where rock-melting offers a logical extension to present drilling and excavating methods, and to identify those areas in which the unique capabilities of the rock-melting system present new technological opportunities. A preliminary investigation is presented in the form of a survey of attitudes and opinions of anticipated users and beneficiaries as to possible advantages, unique capabilities, and potential problems of the new excavation technology. (auth)

5458 (LA-5209-MS) DEVELOPMENT AND CONSTRUCTION OF A MODULARIZED MOBILE ROCK-MELTING SUBTERRENE DEMONSTRATION UNIT. Williams, R. E. (Los Alamos Scientific Lab., N. Mex.). Mar 1973. Contract W-7405-eng-36. 10p. Dep. NTIS $3.00.

A mobile rock-melting rig has been developed for field demonstrations of small-diameter Subterrene penetrators. The design, features, component functions of, and operating data for this modularized field unit are described. (auth)

5459 (LA-5212-MS) DESIGN DESCRIPTION OF MELTING-CONSOLIDATING PROTOTYPE SUBTERRENE PENETRATORS. Neudecker, J. W. (Los Alamos Scientific Lab., N. Mex.). Feb. 1973. Contract W-7405-eng-36. 18p. Dep. NTIS $3.00.

Design details of prototype, refractory metal, melting-consolidating penetrators are given. These rock-melting penetrators form a glass lining on the hole and thus obviate the need for debris removal. In field tests, vertical holes up to 25 m (85 ft) deep and a horizontal hole 16 m long have been completed successfully in tuff. Glass-lined holes have been made in various samples of soils, shales, and wet and dry alluvium. This type of penetrator has been included in the recently completed portable, modularized field demonstration unit. (auth)

5460 (LA-5213-MS) DESCRIPTION OF FIELD TESTS FOR ROCK MELTING PENETRATION. Gido, R. G. (Los Alamos Scientific Lab., N. Mex.). Feb 1973. Contract W-7405-eng-36. 14p. Dep. NTIS $3.00.

The penetration of the earth by melting (Subterrene technique) may facilitate the tunneling and excavating of rock or soil. The acceptance of such an innovation requires early and convincing practical field demonstrations. Such field tests have been performed to produce 2-in. (51-mm)-dia holes up to 82 ft (25 m) deep in local volcanic tuff. Both vertical and horizontal holes have been made. Equipment is discussed and shown to be practical. The following is required to produce a 2-in.-dia hole: a refractory penetrator, a 10-kW electrical power source, a 15-hp coolant air compressor, and a low-load <3000 lb_f (13 kN) stem advancer and retriever. No rotating equipment is needed and no debris removal is required. The rock that is melted to accommodate passage of the penetrator is consolidated into a glass casing as penetration proceeds. Penetrator life is shown to be >100 h. (auth)

5461 (LA-UR-73-459) SUBTERRENE INSTRUMENTATION REQUIREMENTS. Neudecker, J. W. Jr. (Los Alamos Scientific Lab., N. Mex.). 1973. Contract W-7405-eng-36. 6p. (CONF-730510-1). Dep. NTIS $3.00.

From 19th national instrumentation symposium; Las Vegas, Nevada, USA (21 May 1973).

Subterrenes are devices that penetrate in rocks and soils, either horizontally or vertically, by melting rather than by mechanical fracturing. The guidance and rock-melting instrumentation requirements of a small electrically powered geoprospecting Subterrene tunneler are outlined. Possible adaptations of standard commercially available drill-hole survey instruments are discussed, and additional instrumentation development efforts for future, more complex Subterrene tunnelers, are suggested. (auth)

5462 (LBL-1391) SHATTERING ROCK WITH INTENSE BURSTS OF ENERGETIC ELECTRONS. Avery, R. T.; Keefe, D.; Brekke, T. L.; Finnie, I. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 6p. (CONF-730310-28). Dep. NTIS $3.00.

From fifth particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

It has been successfully demonstrated that intense bursts of energetic electrons cause significant rock spalling for modest energy inputs. The corresponding temperature rise per pulse in the bombarded volume of rock is only ~200°C, or so. Some analytical predictions and experimental evidence of this novel accelerator application are presented. The promise of this technique for more rapid and economical tunneling through rock is also examined. (auth)

5463 INDUCTION PUMP FOR CORROSIVE LIQUID METALS. Carbonnel, H.; Borie, R. (to Groupement Atomique Alsacienne Atlantique). French Patent 2,129,132. 27 Oct 1972. Filed date 16 Mar 1971. 12p. (In French).

A compact induction pump for corrosive liquid metals is described in which a layer of liquid metal flux (traversed by an electric current perpendicular to the direction of the flux) is subjected to the action of an electromagnetic force resulting from the interaction between this electric current and a magnetic induction orientated in a direction perpendicular to the current and parallel to the flux. The layer of active flux is defined on two sides by corrosion resistant electrodes and on the other two sides by refractory material which forms the duct, this duct being molded or machined at the time when the pump is constructed. (FR)

5464 SOLENOIDS FOR HIGH OPERATING TEMPERATURES. Nuding, A. Herion-Inform.; 11: No. 3, 105-107(1972). (In German).

Currently there is a demand for magnet valves for use up to 345°C, for example in reactor technology. This requires new temperature-resistant magnet materials. The article shows how HERION solved this problem using Al tape coils. (GE)

5465 HEAT EXCHANGER ELEMENT. Legrand, P. French Patent 95,890. 12 Nov 1971. Filed date 15 Nov 1968. 6p. (In French).

A heat exchanger element is described. It consists of an outer tube for exchange between a heating fluid circulating at its exterior and a vaporizable fluid, and an internal part, which defines an annular space with the outer tube. This space contains a wire which is helically wound around the internal part ensuring the helicoidal flow of the fluid in three successive parts of the element: economizer, vaporizer and superheater. The wire is wound according to at least three different pitches in the three different parts: tightly wound, loosely wound, and averagely wound, respectively. (FR)

5466 COMBINED DEVICE FOR SAMPLING AND DISTILLATION UNDER VACUUM. Jentges, H. (to Siemens AG). German Patent 1,955,988. 13 May 1971. Filed date 7 Nov 1969. (In German)

A device is described for both the sampling and distillation under vacuum of a batch process for the verification of the purity of liquid methane used as a heat transfer agent in nuclear reactors. It is composed of a stainless steel chamber in which the temperature can be regulated. It is fitted with a gas-tight cover fitted with tubes through which samples can be taken. The entire apparatus is fitted with a glovebox and a gas lock. (TSS)

Heat Transfer and Fluid Flow

Refer also to abstracts 5445, 5465, 5601, and 7648.

5467 (AAEC/TM-632) AAEC FREON RIG ACTOR AND INITIAL BOILING CRISIS (BURNOUT) RESULTS. Ilic, V. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1972. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

The closed-circuit heat transfer test loop was designed and built to facilitate the investigation of boiling crisis heat flux and other phenomena in liquid-cooled reactor systems using Freon-12 as a model for high pressure water. The advantages of the modelling technique include low operating power, pressure, and temperature, better reproducibility of boiling crisis heat flux results than obtainable with water, and avoidance of physical damage to test sections due to over-heating. This rig was designed to operate at 2.2 MPa (300 psig) and 100°C with the refrigerant circulated by a canned stator centrifugal pump (maximum flowrate of $6.4 \times 10^{-3}/m^3/s^{-1}$ (85 gpm)). Its design is based on a UKAEA rig at the Atomic Energy Establishment, Winfrith. Test sections are vertical with an upflow of coolant, and can be resistance heated by a dc power supply of up to 450 kW. Rig components, operation and commissioning are described together with comments on the performance and limitations of the rig. First burnout results using a 16 mm (0.633 in.) ID × 2860 mm (112.75 in.) long, stainless steel tube test section are also presented. (auth)

5468 (FEI-348) CONCERNING BOUNDARY STEAM-CONTENT DURING BOILING OF STEAM-LIQUID MIXTURE IN PIPES. Ivashkevich, A. A. (Gosudarstvennyi Komitet po Ispol'Zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko Energeticheskii Institut). 1972. 34p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.75.

Special equations for critical bubble regime during boiling in uniformly heated pipes were examined at low velocities of a two-phase current. The principles involved in an abrupt decrease of the critical heat flow during boiling of a water-steam mixture in long pipes are elucidated. From the equation for critical heat flow, as a special case, an equation was derived for the boundary steam content in long pipes. An equation for the critical steam content was also obtained for short tubes. A comparison with the experimental data from various studies is presented. (tr-auth)

5469 (TID-26335) SUBCOOLED FORCED CONVECTION FILM BOILING IN A VERTICAL ANNULUS. Barnes, W. P. (Illinois Univ., Urbana). 19 Jan 1973. 234p. Dep. NTIS $13.75. Thesis.

Stabilized film-boiling was attained with subcooled water flowing upwards in the cylindrical annulus of a 30-in. vertical test section, 0.75-in. ID and 1.50-in. OD. A wide range of heat flux was obtained through the electrical resistance heating of a 125-mil tube of Hastelloy-C nickel alloy. More than twenty instances of stable film-boiling occurred during eight test runs during which flow rates varied from 0.23×10^6 to 2.31×10^6 lbs/hr-ft^2; water pressures varied from 300 to 750 psia; burnout heat fluxes ranged from 343,000 to 800,000 Btu/h-ft^2; heater surface temperatures ranged from 660 to 1390°F; and film-boiling heat transfer coefficients varied from 430 to 1490 Btu/h-ft^2-°F. Film boiling was, for the most part, local and heterogeneous. From five to ten thermocouples would usually indicate film-boiling simultaneously, but along an axial line rather than in a circumferential one which would fully develop the heater tube. Boiling burnout heat flux increased with flow rate and with water outlet quality or subcooling. The experimental results in this respect fit very well with other published data. Forced convection film-boiling heat transfer was analyzed using both laminar and turbulent boundary layer theory. Reasonable agreement was obtained for the vapor and liquid thicknesses using turbulent boundary layer theory. Computer solutions using experimental burnout heat flux and coolant velocity and thermodynamic properties produced reasonable eddy diffusivity values and turbulent liquid-vapor velocity profiles. (auth)

5470 PLASMA HEAT TRANSFER EXPERIMENTS USING A THERMOCOUPLE. Kanazawa, A. (Tokyo Inst. of Tech.). Heat Transfer—Jap. Res.; 2: No. 1, 63-70(1973).

The heat input rates to a spherical probe immersed in an atmospheric argon plasma with a maximum temperature of 13,200°K were measured by means of the copper-constantan thermocouple, applying potentials ranging from −30 V to 5 V. It was concluded that the heat input rates to the electrically floating probe coincide fairly well with that calculated by the Back's theory, and that, at the highly negative potential, 65% of the joule heating generated around the probe is added to the probe. (auth)

5471 SOME PROBLEMS OF HEAT TRANSFER AND HYDRAULICS IN TWO-PHASE FLOWS. Borishanskii, V. M.; Paleev, I. I.; Agafonova, F. A.; Andreevskii, A. A.; Fokin, B. S.; Lavrent'ev, M. E.; Malyus-Malitskii, K. P.; Fromzel, V. N.; Danilova, G. P. (Leningrad Polytechnic Inst.). Int. J. Heat Mass Transfer; 16: No. 6, 1073-1085(Jun 1973).

Results are presented of the study on heat transfer, hydraulic resistance and heat-transfer crisis for two-phase water−vapor and air−water flows in circular tubes, 5 to 34 mm ID., the relative length being within 45 to 100 dia. Tests were carried out within the following range of parameters: specific heat flux q = 3×10^5 to 3×10^6 kcal/m^{2}h; pressure in a test section P = 1 to 36 atm; mass velocity $w\gamma = 180$ to 5400 kg/m^{2}h; steam quality x = 0.05 to 0.999. Two aspects were studied: (1) the heat-transfer mechanism and resistance in a two-phase flow, i.e. distribution of liquid and gas phases over the tube cross section; mass transfer between the wall film and the liquid suspended in the flow core; measurement of liquid film thickness and the process of wave formation at the film surface; (2) heat transfer and hydraulic resistance to obtain particular engineering recommendations. (auth)

5472 RADIATIVE HEAT TRANSFER BY FLOWING MULTIPHASE MEDIUM. Part 3. An Analysis on Heat Transfer of Turbulent Flow in a Circular Tube. Tamehiro, H.; Echigo, R.; Hasegawa, S. (Kyushu Univ., Fukuoka). Int. J. Heat Mass Transfer; 16: No. 6, 1199-1213(Jun 1973).

Heat transfer by gaseous suspension laminar flow of solid and/or liquid fine particles when the thermal radiation predominates over other modes of heat transfer has previously been elucidated. An analysis is performed on the turbulent flow of the multiphase medium in a circular tube with constant wall temperature. The turbulent flow of gaseous suspension is, however, complicated because of the turbulent behavior of the dispersed particles and the carrier fluid. The tractable model has therefore been employed by taking account of not only the radiative heat transfer to the particulate phase but also the heat transfer between particles and surrounding fluid associated with turbulence. The reduced basic equations constitute simultaneous integro-differential equations which are solved numerically by the implicit finite difference method with iterative procedure of the radiative terms. The calculated results on the temperature profiles and the heat transfer are examined in details. (auth)

5473 LEIDENFROST TEMPERATURE: ITS CORRELATION FOR LIQUID METALS, CRYOGENS, HYDROCARBONS, AND WATER. Baumeister, K. J.; Simon, F. F. (Lewis Research Center, Cleveland). J. Heat Transfer; 95: No. 2, 166-173(May 1973).

A prediction technique for the Leidenfrost and minimum temperatures is presented which considers the effects of the critical temperature of the liquid, thermal properties of the solid, surface energy of the liquid, and surface energy of the solid. The prediction technique is in good agreement with data for liquid metals, cryogens, hydrocarbons, and water. (auth)

5474 INCIPIENT-BOILING SUPERHEATS FOR SODIUM IN TURBULENT CHANNEL FLOW: EFFECT OF RATE OF TEMPERATURE RISE. Dwyer, O. E.; Strickland, G.; Kalish, S.; Hlavac, P. J.; Schoener, G. A. (Brookhaven National Lab., Upton, NY). J. Heat Transfer; 95: No. 2, 159-165(May 1973).

Using sodium, an experimental study was carried out to determine the effect of rate of temperature rise on the incipient-boiling superheat for fully developed, forced turbulent flow. Three different methods of achieving boiling inception were used. The magnitude of the incipient-boiling superheat was found to be quite reproducible and independent of the experimental method as long as the rate of temperature rise (temperature ramp) was kept constant and kept the same. Moreover, the value of the superheat was found to have a strong dependency on the temperature ramp—the greater the ramp, the larger the superheat. The failure to carefully measure and control temperature ramp is apparently one reason why incipient-boiling-superheat data generally show so much scatter, and those from different laboratories so much disagreement. (auth)

5475 SONIC LIMIT IN SODIUM HEAT PIPES. Levy, E. K.; Chou, S. F. (Lehigh Univ., Bethlehem, PA). AT(30-1-4095. J. Heat Transfer; 95: No. 2, 218-223(May 1973).

The results of an analytical study of the vapor dissociation−recombination and homogeneous vapor condensation phenomena in sodium heat pipes are described. It is shown that neither the dissociation−recombination reaction nor the vapor condensation process has a large influence on the sonic-limit heat transfer rate. The single most important factor is shown to be the wall shear stress in the heat-pipe vapor passage. The friction effects control the location of the sonic point, determine if the flow in the condenser section will be subsonic or supersonic, and decrease the sonic-limit heat transfer rate to values which can be substantially lower than those which are predicted from inviscid analyses. (auth)

5476 MATHEMATICAL MODEL FOR TRANSIENT SUBCHANNEL ANALYSIS OF ROD-BUNDLE NUCLEAR FUEL ELEMENTS. Rowe, D. S. (Battelle-Northwest, Richland, WA). Contract AT(45-1)-1830. J. Heat Transfer; 95: No. 2, 211-217(May 1973).

A mathematical method is presented for analyzing transient flow and enthalpy transport in rod-bundle nuclear fuel elements during both boiling and nonboiling conditions. A mathematical model is formulated by dividing the bundle flow area into flow subchannels that are assumed to contain one-dimensional flow and are coupled to each other by turbulent and diversion crossflow mixing. The mathematical model neglects sonic velocity propagation and neglects temporal and spatial acceleration in the transverse momentum equation. A semiexplicit finite-difference scheme is used to perform a boundary-value solution where the boundary conditions are the inlet enthalpy, inlet flow rate, and exit pressure. Calculations are presented to show the effect of rapid changes in heat flux, inlet enthalpy, and inlet flow rate on the subchannel flow and enthalpy distribution in rod bundles. (auth)

5477 PHYSICAL FLUID DYNAMICS. McCormack, P. D.; Crane, L. New York; Academic Press, Inc. (1973). 506p. $17.50.

A comprehensive introduction to modern fluid dynamics, i.e., the study of the equilibrium and motion of fluids, is presented which emphasizes the physical aspects of real, rather than ideal, fluids. The following subjects are discussed: mathematical background of fluid dynamic studies, including an appendix on vector operations and identities; physical properties of fluids; fluid flow kinematics; equations of fluid motion; vortex dynamics; vorticity and the laminar boundary layer; slow viscous flow; unsteady flow, stability, and turbulence; compressible fluid flow; particle fluid dynamics; and the hydrodynamics of superfluids. (LCL)

5478 ANALYTICAL METHODS IN CONDUCTION HEAT TRANSFER. Myers, G. E. New York; McGraw-Hill Book Company (1971). 521p. $19.50.

A textbook on conduction heat transfer is presented. This text was designed to provide the first year graduate student with the mathematical background necessary for solving advanced conduction heat transfer problems. The chapter headings include: review of elementary problems; Bessel's equation and related functions; separation of variables; superposition; complex combination; Laplace transforms; normalization; finite differences; and finite elements. (LCL)

Materials Testing

Refer also to abstracts 6241, 6921, 7639, and 7640.

5479 (CONF-730606-1) ADVANCES IN ELECTRODISCHARGE MACHINING OF REFERENCE FLAWS. Cook, K. V.; McClung, R. W.; Whaley, H. L. (Oak Ridge National Lab., Tenn.). 1973. 6p. Dep. NTIS $3.00.

A basic problem in applying valid nondestructive tests continues to be obtaining a true reference discontinuity. Electrodischarge-machined (EDM) discontinuities are presently accepted by nondestructive testing (NDT) personnel as one of the better types of standards for establishing proper instrument calibration and test sensitivity, although file marks, flat-bottom drilled holes, end-mill-machined notches, saw-cut notches, naturally occurring discontinuities etc. are used as references by many inspectors. The development of the capability to machine EDM references and measure their dimensions is discussed. Advances in techniques center around modifications of equipment and addition of accessory equipment. However, sharp crackline notches required for mechanical testing also have been fabricated. This type of notch is more difficult and expensive to obtain but may be more representative of natural flaws that occur in fabricated materials. EDM discontinuities are an asset to NDT and are recommended for calibrating instrumentation especially for critical applications such as in the nuclear field; however, these EDM discontinuities such as holes and notches, are becoming essential for destructive tests also. (auth)

5480 (DUN–8056(Rev.1)) SETUP AND ADJUSTMENT PROCEDURES FOR THE NONDESTRUCTIVE TESTERS N FUELS PRODUCTION DIVISION. (Douglas United Nuclear, Inc., Richland, Wash.). 19 Mar 1973. 23p. Dep. NTIS $3.25.

Methods to be used for setting up and adjusting the nondestructive test equipment which is used for the testing of the cap-to-core bonds, cap-to-clad bonds, clad-to-core bonds, and clad thickness of B09, X09, A12, and N09 models of fuel elements are described. Use of these procedures will provide for the controlled nondestructive testing of production fuel elements in accordance with the procedures detailed in DUN-M-29 to assure conformance to DUN-5601, Manufacturing Process Specifications. (auth)

5481 (UCRL–74515) ACOUSTIC EMISSION COINCIDENCE DETECTOR FOR MONITORING HIGH RESIDUAL STRESS AREAS IN SYMMETRICAL PRESSURE VESSELS. Sewall, N. R. (California Univ., Livermore. Lawrence Livermore Lab.). 7 Mar 1973. 8p. (CONF-730510–2). Dep. NTIS $3.00.

From 19th national instrumentation symposium; Las Vegas, Nevada, USA (21 May 1973).

In pressure vessels where high residual stress areas are suspected, acoustic emission can be valuable nondestructive testing tool in the process of proofing the vessel. Naturally, the suspected areas of failure would be in the inlet-tube connection weld or braze, or a waist weld in the part itself. Welding destroys the homogeneity of the base metal itself; hence, one can suspect high residual stresses left in the base metal after welding has taken place. In proof testing, by judicious placement of acoustic emission transducers along with the described flaw detection coincidence circuitry, a vessel can be checked or somewhat certified against high residual stress areas causing microcracks, by the acoustic emission addition to the proof test. The problem and the proposed solution are discussed including the acoustic flaw window, acoustic velocity in the material, reflection or reradiation of bursts, the placement of transducers, and the final circuit. The results have been very helpful in the certification of the vessels. (auth)

5482 (UCRL–74549) ACOUSTIC EMISSION TECHNIQUES IN NONDESTRUCTIVE TESTING. Liptai, R. G.; Tatro, C. A. (California Univ., Livermore. Lawrence Livermore Lab.). 6 Feb 1973. 12p. (CONF-730606–3). Dep. NTIS $3.00.

Acoustic emissions are defined as transient elastic waves that are generated by the rapid release of energy within a material as a result of the application of external energy sources. Common mechanisms for the generation of acoustic emission activity include plastic deformation, crack initiation, and crack propagation. In one sense, acoustic emission techniques for nondestructive testing (NDT) and evaluation are different from those usually associated with the field. The basis for most conventional NDT methods is interpretation of the interaction of a defect or discontinuity with some sort of energy (x-rays, ultrasonics, thermal energy, microwaves). In acoustic emission, the defect or discontinuity itself provides a source of energy, the release of which generates the acoustic emission. In this sense, the defect plays an active role in preference to the passive role it usually plays during the evaluation by conventional NDT methods. A review is given of the application of emission analysis to evaluate materials properties and defect structure. Emphasis is placed on a discussion of emission techniques as applied to the evaluation of structural integrity of materials, components, and structures. The characteristics of acoustic emission methods as a unique NDT technique are presented. Examples of the current status of the application of acoustic emission for NDT are reported and future applications and developments are discussed. (auth)

5483 (WAPD-TM–1086) INELASTIC COLUMN BUCKLING OF INTERNALLY PRESSURIZED TUBES. LWBR Development Program. Newman, J. B. (Westinghouse Electric Corp., Pittsburgh, PA. Bettis Atomic Power Div.). Apr 1973. Contract AT-11-1-Gen-14. 16p. Dep. NTIS $3.00.

The Incremental Theory and the Deformation Theory of Plasticity are used to analyze column buckling of internally pressurized tubes subjected to axial thrust, and the results are compared to the buckling loads determined in tests of annealed aluminum tubes. By using stress–strain curves obtained from tensile tests of tubing samples, reliable predictions are obtained with Incremental Theory. However, the results of Deformation Theory are so conservative as to cast doubt on the usefulness of this theory for buckling analyses. (auth)

5484 RADIATSIONNAYA INTROSKOPIYA. (Radiation Introscopy). Dobromyslov, V. A.; Rumyantsev, S. V. Moscow; Atomizdat (1972). 352p.

This monograph presents the physical and technological bases of radiation-introscopic techniques for nondestructive testing and control of "internal" defects or nonhomogeneities in opaque objects. Sources of useful radiation are discussed: x-rays, bremsstrahlung, neutrons, and radioisotopic sources. Ionizing radiation converters and image intensifiers are discussed, with particular reference to fluroscopic, scintillation, and electroluminescent screens, image contrast, and electro-optic and thermoluminescent converters. The sensitivity and performance of radiation introscopic methods are explored. The last part of the book is devoted to industrial uses and equipment, dosimetry, and protection. (KSW)

5485 ADVANCED EXPERIMENTAL TECHNIQUES IN THE MECHANICS OF MATERIALS. Conference Held in San Antonio, Texas, September 9–11, 1970. Francis, P. H.; Lindholm, U. S. (eds.). New York; Gordon and Breach, Science Publishers, Inc. (1973). 459p. (CONF-700907–). $22.50.

From symposium on advanced experimental techniques in the mechanics of materials; San Antonio, Texas, USA (9 Sep 1970).

Sixteen expository papers are included on various topics in experimental mechanics and nondestructive testing. The papers address four general problem areas: surface defect characterization, internal defect structure, surface deformation and strain, and stress state and fracture. Techniques discussed include magnetic methods, EPR, Moessbauer spectroscopy, Barkhausen effect, acoustic emission, laser interferometry and holography, ultrasonics, and internal friction. Closing comments by session chairmen are included, as also are author and subject indexes. (DLC)

5486 BETATRONY V DEFEKTOSKOPII. (Betatrons and Defectoscopy). Vorob'ev, V. A.; Gorbunov, V. I. Moscow; Atomizdat (1973). 176p.

This small monograph treats the use of the betatron in defectoscopy, using bremsstrahlung in radiographic and radiometric methods. The design and construction of automatic betatron defectoscopes to be employed in industrial laboratories are discussed, and selection of the optimum parameters for such equipment is elucidated. A number of features of radiographic and radiometric control in the nondestructive testing of materials and the economics involved are examined. 32 references. (KSW)

5487 NEUTRON IMAGING WITH THIN GADOLINIUM CONVERTERS. Harms, A. A.; Blake, T. G.; Marton, J. P. (McMaster Univ., Hamilton, Ont.). Nucl. Instrum. Methods; 109: No. 2, 253-255(1973).

The optical density obtainable with thin gadolinium converters in a neutron radiographic imaging system has been investigated. An analysis between experimental and theoretical results has been undertaken to elucidate the dependence of optical density on system parameters. It has also been found that converter-foil backings contribute to optical density. (auth)

5488 NON-DESTRUCTIVE TESTING OF SILICON CARBIDE TUBES. Rooney, J. (United Kingdom Atomic Energy Authority, Springfields, Eng.). Non-Destruct. Test. (Guildford, Eng.); 6: No. 3, 146-151(Jun 1973).

The development of three nondestructive methods for testing silicon carbide fuel-sheathing is described. The ultrasonic method provides a sensitive flaw test for tubes, the eddy-current method shows promise as a simpler flaw test for tubes, and radiography provides a complementary test for suspect tubes and a means of examining sealing welds. (auth)

Nuclear Explosions

Refer also to abstracts 5218, 5530, 5531, 5815, 6108, and 7616.

5489 (AD-751960) LONG PERIOD SEISMOLOGICAL RESEARCH PROGRAM. Semiannual Report. Sykes, L. R.; Savino, J. M. (Columbia Univ., Palisades, N. Y. Lamont Doherty Geological Observatory). 25 Oct 1972. Contract F44620-71-C-0082. 19p. (AFOSR-TR-72-2188). NTIS.

The most significant result of the data analysis pertinent to the earthquake-explosion discrimination problem is based on the study of surface wave detection thresholds. Inclusion of data from the stations at Eilat, Israel, and Kongsberg, Norway show that long-period surface waves are observed from many shallow earthquakes located in central Asia with magnitudes from $m_b = 4.1$ to 4.5. These relatively low threshold values can often be lowered by 0.2 to 0.3 m_b units by means of digital filtering techniques (polarization and azimuthal) thereby extending the applicability of the $m_s - m_b$ discriminant to smaller magnitude events. (auth))

5490 (AD-753244) SIMULATION FOR THE ASSESSMENT OF TACTICAL NUCLEAR WEAPONS (SATAN II). General Description. Computer System Manual. Lautzenheiser, M. W.; Bales, W. B.; Fletcher, N. H.; Eoff, D. A.; Koehler, R. B. (National Military Command System Support Center, Washington, D. C.). 15 Sep 1972. 33p. NTIS.

The manual describes briefly the Simulation for the Assessment of TActical Nuclear Weapons (SATAN 2). The SATAN 2 simulation is a model for the two-sided, open play of tactical nuclear weapon exchanges on simulated battle-fields. When provided by the user with the required input data, the SATAN 2 computer programs will automatically deploy forces, acquire targets, allocate nuclear weapons to fire on those targets, assess the effects of those fires, perform computer-battery operations, and interface with a tactical, logistical, and air simulation. The SATAN 2 Model is programmed in FORTRAN 4 for use on the IBM 360/50 computer. (auth)

5491 (AD-753805) FUNDAMENTAL BLAST STUDIES. Final Report. Giglio-Tos, L. (Defense Nuclear Agency, Washington, D. C.). 22 Dec 1972. 77 p. (DNA-POR-6744; AEC-WT-6744). NTIS.

Free-field airblast parameters were measured from the detonation of a spherical 500-ton TNT charge. The charge was placed on the ground such that its height of burst would be one radius above the earth's surface. Measured values of shock-wave arrival time, maximum overpressure, positive phase duration, overpressure impulse, dynamic pressure, and dynamic pressure impulses are presented as functions of ground range and are compared with predictions generated from scaled empirical and theoretical data. Results are compared with those from PRAIRIE FLAT. (auth)

5492 (AD-755100) CONSTRUCTION OF NUCLEAR GEOSTORAGE FACILITIES FOR PETROLEUM PRODUCTS. Sprague, K. E. (Army Engineer Waterways Experiment Station, Livermore, Calif. (USA). Explosive Excavation Research Lab.). Jun 1972. 97p. (EERL-TR-E-72-26). NTIS.

The feasibility of constructing nuclear explosion cavities to be used as hardened storage facilities for automotive and aviation fuels in a Theater of Operations is examined. It is concluded that void volumes of from 50,000 to 250,000 barrels capacity, for substitution into the Engineer Functional Components Systems, could safely and reliably be created. Stored products could be discharged using submersible turbine pumps, hydraulic displacement, or where terrain allows, gravity flow. Waiting three months after the detonation to inject the petroleum product into the nuclear geostorage container would preclude degradation of critical fuel properties from radiation damage. (auth)

5493 (AD-755883) RELEASE OF TECTONIC STRAIN BY LARGE UNDERGROUND NUCLEAR DETONATION. Final Report Turpening, R. M. (Michigan Univ., Ann Arbor. Inst. of Science and Technology). Jan 1973. Contract F44620-70-C-0086. 44p. (AFOSR-TR-73-237). NTIS.

An attempt to observe SH waves from several large underground nuclear explosions at first-zone distances (<600 km) from each event is described. The data base was supplemented by seismograms from the World Wide Standard Station Network and Canadian Network. Good SH arrivals were observed at the shorter ranges (<250 km) but not at ranges between 250 km and about 1800 km. In an effort to detect the arrival of any S waves (SV or SH) within this "shadow zone," a flat-layered earth approximation was assumed (with hence critically refracted S-wave paths), and particle motion diagrams were then constructed. (The flat-layered earth hypothesis suggests small angles of incidence and, therefore, rectilinear particle motion). Such rectilinear motion was observed and in several "shadow-zone" instances, arrival times were consistent with the model chosen. (auth)

5494 (CGS-746-102) ALEUTIAN SEISMICITY: MILROW SEISMIC EFFECTS. Engdahl, E. R.; Tarr, A. C. (Coast and Geodetic Survey, Rockville, MD). May 1970. 59p. Dep NTIS $5.00.

A review of the spatial and temporal characteristics of historical Aleutian seismicity and of low-level earthquake activity detected by a network of high-frequency high-gain stations suggests that earthquake activity in the Amchitka Island region is the result of at least two types of tectonic processes; namely, the movement of independent crustal blocks of the Aleutian arc and the large-scale underthrusting of the Aleutian arc by a moving oceanic plate. The careful monitoring of earthquake patterns preceding and following MILROW revealed no evidence for any significant spatial or temporal changes in the natural seismicity. There occurred, however, immediately after detonation, in a zone not more than 3 miles in radius from ground zero, a swarm of hundreds of very small earthquakes which terminated abruptly 37 h later at the time of the MILROW cavity collapse. Since they were very small, of short duration, and occurred in the immediate vicinity of the explosion, they are not believed to constitute a hazard to the major fault zone under Amchitka Island. (auth)

5495 (D-754087) EFFECTS OF STRONG EXPLOSIONS. V. (Soviet Literature Translations). Report No. R-760/4 ARPA. Kassel, S. (Rand Corp., Santa Monica, Calif.). Aug 1972. Contract DAHC15-67-C-0141. 66p. NTIS.

English-language abstracts of about 45 Soviet technical writings on the effects of strong explosions, particular nuclear explosions, and their simulation under laboratory and field conditions are presented. The articles abstracted appeared in 1971 and early 1972. The abstracts are arranged under these general headings: shock waves in gas; equations of state for gas; exploding wires; hypersonic flow past bodies; atmospheric physics; soil mechanics; laser simulation and related effects; particle beams; and electromagnetic field interaction with materials. The abstracts vary in length according to the pertinence and significance of the original papers. The usual glossary of journal abbreviations is included. (auth)

5496 (JPRS-59039) OIL RECOVERY BY NUCLEAR EXPLOSION. Shadrin, L. Translated from Nauka Zhizn; No. 2, 14-19(1973). 11p. NTIS $3.00.

The feasibility of using nuclear explosions for stimulation of oil wells for a more complete recovery of the oil is examined. Recovery of natural gas and the construction of underground storage facilities using nuclear explosions are briefly mentioned. (TFD)

5497 (PNE-RB-41) CONDITION SURVEY OF WELLS AND SPRINGS IN THE RIO BLANCO PROJECT AREA, RIO BLANCO COUNTY, N. W. COLORADO. (CER Geonuclear Corp., Las Vegas, Nev.). 10 Jan 1973. 14p. Dep. NTIS.

Methods used to survey the predetonation condition of springs and wells on the Rio Blanco site in Colorado are described. The survey results are tabulated. Information is included on: the location of 36 springs; the use, chemical composition, pH, and electric conductivity of water from each spring; the location, physical characteristics, and water use of 61 wells; and the chemical analysis of water sampled from 14 wells. (LCL)

5498 (PNE-RB-42) DIFFUSION AND DOSE CALCULATIONS FOR PROJECTS RIO BLANCO AND WAGON WHEEL. Peterson, K. R. (California Univ., Livermore. Lawrence Livermore Lab.). 28 Apr 1972. 25p. (PNE-WW-25. Dep. NTIS $3.25.

The procedures are described which were used at Lawrence Livermore Laboratory in arriving at estimates of surface concentrations and dose to individuals for ^{3}H and ^{85}Kr from flaring of natural gas produced by the Rio Blanco and Wagon Wheel Events and for ^{133}Xe and ^{131}I due to a possible, but unlikely, seep of gases shortly after detonation. (LCL)

5499 (PNE-RB-43) PREDETONATION RIO BLANCO HYDROLOGIC TESTING FOR PERIOD FEBRUARY 1, 1973–May 1, 1973. (CER Geonuclear Corp., Las Vegas, Nev.). 3 May 1973. 69p. Dep. NTIS.

Hydrologic testing at the Rio Blanco emplacement area during February to May 1973 is described, and available data on transmissivity, static water level, and storage coefficient are tabulated. (LCL)

5500 (SC-RR-720547) PRESSURES IN WATER ON AND NEAR AMCHITKA ISLAND, MILROW, AND CANNIKIN. Merritt, M. L. (Sandia Labs., Albuquerque, N. Mex.). Feb 1973. 85p. Dep. NTIS $3.00.

Measurements of sea floor ground motion and water pressures resulting from explosions in the underlying rock were taken: in the Milrow nuclear shot, in the moderately deep water of the surrounding sea; in the Cannikin nuclear shot, in on-shore ponds and streams. Repeated reflections from the water surface and the sea floor were found to modify the pressure wave shapes from those encountered in rock. In Milrow's deep water measurements, this principally resulted in reduced peak pressures; in Cannikin's shallow water measurements, pressure waveforms closely resembled acceleration waveforms. A simple but adequate theory describing these phenomena has been developed. Spall and/or cavitation in water generally results in spray and geysering in on-shore ponds and streams, and white water and spouts offshore. Bulk or distributed cavitation was apparently present on Cannikin to a much greater extent than on Milrow. (auth)

5501 (SLA-73-494) ELECTRON ATTACHMENT AND AVALANCHING ASSOCIATED WITH EMP CALCULATIONS FOR HIGH-ALTITUDE BURSTS. Vittitoe, C. N. (Sandia Labs., Albuquerque, N. Mex.). 1972. 26p. (CONF-730516-1). Dep. NTIS $3.50.

From DNA EMP Phenomenology Working Group meeting; Albuquerque, New Mexico, USA (3 May 1973).

The electron attachment and avalanching parameters currently in the SHARP code have been collected in a form which should facilitate comparison with parameters used in other codes. The method of obtaining the necessary data and the conversion for EMP codes are discussed. A limited comparison is made between the representations in SHARP and those in use elsewhere. (auth)

5502 (TID-26276) CRATERING IN LAYERED MEDIA. Vesic, A. S.; Ismael, N. M. F.; Bhushan, K. (Duke Univ., Durham, N. C. (USA). School of Engineering). Aug 1971. 45p. (EERL-TR-E-72-31). Dep. NTIS $3.00.

The effects of a layered medium on cratering phenomena were studied. The study included 32 small-scale model tests in which the layered medium consisted of a compressible stratum of compacted sand and a stiff stratum of an artificial sandstone. Parameters under study included crater dimensions, subsurface deformation patterns, and surface velocity as functions of charge burial depth and layer configuration. The tests included half-space and quarter-space models. In the latter, the charge was placed adjacent to a transparent side of the test fixture to permit photography of dynamic phenomena. Spherical 1.68-g charges of lead azide were used in the half-space tests, and 0.84-g hemispherical charges were used in the quarter-space tests. In most of the tests the stiff stratum was situated below the compressible stratum. The test results indicated that the existence of layering had considerable influence on cratering phenomena if the interface between the upper and lower strata was nearer to the surface than three times the charge burial depth. For the case in which the charge was located in the compressible layer and the compressible layer was on top, craters were found to be deeper, but smaller in diameter, than those formed in a compressible homogeneous medium. Surface velocities were also increased in this case. Initial explosion cavity growth and the final subsurface deformation patterns were also strongly influenced by the relative position of the interface. For the case in which the stiff layer was on top and the charge was detonated in the compressible layer, a greater portion of the explosive energy was used to create a charge cavity in the compressible layer, thereby decreasing the maximum charge depth at which breakthrough to the free surface occurred. (auth)

5503 (TID-26277, pp 91-99) NATIONAL SECURITY. 1973. 1972 Atomic Energy Programs: Operating and Developmental Functions.

The contributions of USAEC activities during 1972 to the national security are reviewed. These activities included: continued development of nuclear weapons approved for entry into the US stockpile; performance of underground nuclear explosion tests under the restrictions of the limited test ban treaty; maintenance of an atmospheric test readiness capability; continuance of the Vela Program with Vela Uniform activities for improved detection of underground nuclear explosions and the Vela Satellite activities for monitoring atmospheric and in-space explosions; and the development of a nuclear-propelled fleet of both surface and submarine vessels. (LCL)

5504 (TID-26311) PROJECT CANNIKIN. (Atomic Energy Commission, Washington, D. C.). May 1971. 42p. Dep. NTIS $4.25.

Cannikin was an underground nuclear test on Amchitka Island, Alaska, of an experimental device which had a yield of less than five megatons. The test was considered to be of vital importance to national security. Background information on the project is presented and includes: reasons for site selection; estimated bioenvironmental and seismic effects of Cannikin; comparison of predicted and actual physical effects of Milrow event; public safety aspects; availability of test information; scientific contributions of USAEC's Amchitka programs; program for transplanting sea otters to areas where they had become extinct; and miscellaneous facts about Amchitka Island. (LCL)

5505 (UCRL-51358) SOME OBSERVATIONS RELATED TO MODELING EXPLOSIVE CRATERING PHENOMENA. White, J. W. (California Univ., Livermore. Lawrence Livermore Lab.). 27 Mar 1973. Contract W-7405-eng-48. 82p. Dep. NTIS $6.25. Thesis.

One of several applications studied in the Plowshare Program (Peaceful Uses of Nuclear Explosives) involves the formation of large craters on the surface of the earth. For nuclear cratering to become an efficient engineering tool, it is necessary to predict the results of a cratering shot. The two techniques most frequently used to predict the dimensions of a crater involve empirical formulas and computer calculations. This thesis presents improved methods for both of these approaches. The empirical formulas have consisted of statistical correlations of crater dimensions as a function of yield (explosive size) and depth of burial. There has not been a successful attempt to provide a quantitative theoretical model for the cratering process. A quantitative theoretical model of the cratering process is proposed, and it results in a formula predicting the crater size. Experimental data are used to determine empirically the value of the terms which are obtained from the derivation of the formula. An improved method for describing the failure surface of a material is presented. This description is incorporated in a failure model used in computer calculations for modelling rock mechanics. Other aspects of modelling rock failure are also incorporated in this model. They include stress relaxation and the manner in which failure surfaces change. Finally, an improved method for treating shocks has been developed for continuum mechanics simulation on a computer. All of these computational developments contribute to an improved capability for simulating rock mechanics phenomena which in turn will aid in improving the tools for predicting the results of explosive cratering projects. (auth)

5506 (UCRL-51359) PREDICTION OF DRY FALLOUT FROM LOW YIELD SURFACE AND UNDERGROUND ATOMIC DEMOLITION MINES. Peterson, K. R.; Knox, J. B.; Gibson, T. A. Jr.; Lawson, L. A. (California Univ., Livermore. Lawrence Livermore Lab.). 7 Mar 1973. Contract W-7405-eng-48. 14p. Dep. NTIS $3.00.

A rapid nomographic technique is presented for estimating dry fallout and determining exclusion zones in the deployment of atomic demolition mines. Solutions include base surge (BS) and main cloud (MC) fallout patterns for yields from 0.01 to 10 kt and for scaled burial depths of 0 to 150 ft/kt$^{0.294}$. It also treats a wide variety of winds, from very light to very strong with extreme wind shear. An error analysis shows at most a 30% overprediction, ranging to a 20% underprediction, of the distances covered by the exclusion zones. An example is included and discussed. This technique eliminates the time-consuming wind hodograph typical of previous fallout prediction methods. Learning the method takes only a few hours of study. Only a geographical map, a recent upper air wind report, and a straightedge, protractor, and draftsman's compass are needed. (auth)

5507 RIO BLANCO: STIMULATING GAS AND CONFLICT IN COLORADO. Carter, L. J. Science; 180: No. 4088, 844-848 (25 May 1973).

The Rio Blanco Project is criticized with emphasis being placed on the fact that several thousand such shots would be necessary to recover the natural gas from the Piceance Basin in northwestern Colorado. (TFD)

Protective Structures and Equipment

Refer also to abstract 6496.

5508 GAMMA-RAY ATTENUATION IN BASEMENT CEILINGS. Reynolds, R. S. (Mississippi State Univ., State College). Nucl. Sci. Eng.; 51: No. 2, 102-112(Jun 1973).

Experiments have been performed which give further insight into the so-called "in-and-down" scattering problem. Experimental ceiling attenuation factors have been developed and compared with previously published results of radiation attenuation in basement ceilings. The experiments were performed on a full-scale structure with basement ceiling mass thicknesses of 12 and 0 psf at several solid angle fractions. Additional experiments were performed for several ceiling mass thicknesses at a solid angle fraction near unity. Generally, the experiments showed that previously published ceiling attenuation factors appear inadequate for large solid angle fractions and large overhead mass thicknesses. For small mass thicknesses and solid angle fractions below ~0.8, the agreement between experiment and previously published results is reasonable. It is clear that ceiling attenuation factors should demonstrate a solid angle fraction dependence as well as a mass thickness dependence. However, these experiments show that there is no reason to believe that in the limit as the solid angle fraction approaches unity, the ceiling attenuation factor should approach old formulations which had no solid angle fraction dependence. It has also been shown in this work that ceiling attenuation factors may be experimentally determined solely from finite field data. There is no need to estimate far-field contributions or skyshine contributions in the determination of ceiling attenuation factors. (auth)

5509 ZASHCHITNYE SOORUZHENIYA V PODZEMNYKH VYPABOTKAKH. (Protective Structures in Subterranean Mines). Ponikarov, N. D.; Chumakov, V. I. Moscow; Atomizdat (1973). 64p.

Recommendations for the use of natural caves and underground mine shafts for protection against atomic blasts are given. Civil defense needs such as the availability of water, food stocks, and adequate ventilation are discussed. The seismic and air-transmitted effects of shock waves, and the radii of effective blast damage are discussed in some detail. 14 references. (KSW)

5510 SREDSTVA INBIVIDUAL'NOI ZASHCHITY DLYA RABOT S RADIOAKTIVNYMI VESHCHESTVAMI. (Media for Individual Shielding for Work with Radioactive Substances). Gorodinskii, S. M. Moscow; Atomizdat (1973). 296p.

Fundamental theoretical and practical shielding problems concerning the individual worker who must deal with radioactive substances are examined. Recommendations are made on handling radioactive aerosols and mists. Respirators, gas masks, and filtering media for lung protection are described and illustrated. Many types of protective clothing are treated in detail: coveralls, footwear, rubber gloves, special head coverings, and a number of complex total-insulation designs such as tent-costumes. Most available fabrics are evaluated for these applications. Decontamination procedures for individual shielding media are given. 426 references. (KSW)

Safety Engineering

5511 (SC-M-70-889) MANUAL FOR INDUSTRIAL SAFETY, FIRE PREVENTION, ENVIRONMENTAL HEALTH. (Sandia Labs., Albuquerque, N. Mex.). 7 Jan 1971. 192p. Dep. NTIS $11.75.

Includes change 1 dated 5 Mar 1971 and change 2 dated 30 Sep 1971.

A safety manual for the Sandia Laboratory is presented which explains the safety responsibilities, reporting procedures, and safety programs related to: fire prevention; industrial safety in offices and materials handling facilities and the special industrial safety requirements for working with electrical equipment, explosives, pressurized systems, and welding apparatus; and the health hazards in dealing with toxic materials, radioactive materials, and radiation machines. (LCL)

5512 MATERIALY I KONSTRUKTSII ZASHCHIT YADERNYKH USTANOVOK. (Materials and Construction of the Shielding of Nuclear Installations). Komarovskii, A. N. (ed.). Collection of Moscow Engineering and Construction Institute, No. 77. Moscow; Izdatel'stvo Nauka (1971). 139p.

The collection contains the results of studies that can be used during design and construction of the radiation shielding of nuclear reactors and accelerators, and during construction of hot laboratories. The collection is intended for scientific workers and engineers working in the field of planning and construction of objects of the atomic industry, and also for students specializing in this field. (JPRS)

5513 IMPROVEMENTS IN A METHOD OF AND MEANS FOR COMBATING SODIUM FIRES. Broadley, D. (to United Kingdom Atomic Energy Authority). British Patent 1,307,683. 21 Feb 1973. Filed date 17 Dec 1969. 4p.

A method is described for combating Na fires, arising from escape of molten Na from a conduit or containing vessel. The molten Na is directed to fall through a perforated plate into a container sealed to the plate, and a non-hygroscopic non-toxic dry particulate material, compatible with Na, is spread on the plate to form a blanket. The particle size of the particulate material is such that a significant proportion is retained on the plate. Suitable particulate materials are delaminated exfoliated vermiculite and perlite. Preferably an inert atmosphere is established between the container and perforated plate. The perforated plate and container are preferably situated to one side of the region vertically below the leak, with an inclined surface for directing the Na. (UK)

Vacuum Engineering

Refer also to abstract 6709.

5514 HIGH AND ULTRAHIGH VACUUM BY PUMPING WITH CRYOCOOLED SURFACES. Mullen, L. O. (National Bureau of Standards, Boulder, CO). AIChE Symp. Ser.; 68: No. 125, 24-30 (1972).

The principles of pumping with cryogenically-cooled surfaces to produce high and ultrahigh vacuum are reviewed. The theory of cryopumping and entrapment by cryopumping, as well as some advantages and limitations, are discussed. (auth)

5515 SURFACE PHENOMENA AT LOW PRESSURES AND TEMPERATURES. Hobson, J. P. (National Research Council, Ottawa). AIChE Symp. Ser.; 68: No. 125, 16-23(1972).

Vacuum technology becomes increasingly controlled by surface phenomena as both the pressure and temperature are lowered. The dominant physical processes are adsorption, desorption, surface chemical reactions, and diffusion. An outline of the role played by these processes in the operation of pumps, gages, and vacuum systems is given. (auth)

ENVIRONMENTAL AND EARTH SCIENCES

Refer also to abstract 7622.

5516 (AEC-tr-7223/9-10) NUKLEONIKA, VOL. 16, NO. 9-10, 1971. Translated from Nukleonika; 16: No. 9-10, 399-512 (1971). 104p. (TT-70-55104/9-10). Dep. NTIS $5.45.

Minerals and Ores

Refer also to abstract 5256.

5517 (TID-26294) EXAMPLES OF OVERALL ECONOMICS IN A FUTURE CYCLE OF URANIUM CONCENTRATE PRODUCTION FOR ASSUMED OPEN PIT AND UNDERGROUND MINING OPERATIONS. Klemenic, J. (Grand Junction Office (AEC), Colo. Ore Reserves and Production Div.). 20 Oct 1972. 36p. Dep. NTIS $4.00.

An economic comparison of open pit mining vs underground mining is presented that considers the effect of ore grade on total costs, effect of ore grade on internal rate of return, effect of ore depth to ore thickness ratio on total costs, and effect of exploration cost on total costs. It was concluded that under the assumptions selected for the base case, total production cost when utilizing open pit mining is $1.30/lb less than underground mining and the price at which a 12% rate of return is generated is about $2.00/lb less for the open pit mining than for the underground mining; and at a common ore grade and production rate, total production cost for open pit mining is from $1.00 to $3.70/lb less than for the underground mining and the price at which a 12% rate of return is generated about $2.50/lb less for the open pit mining than for the underground mining. (DHM)

5518 (WASH-1243) NUCLEAR FUEL RESOURCES AND REQUIREMENTS. (Division of Production and Materials Management (AEC), Washington, D. C.). Apr 1973. 55p. GPO $0.80.

Uranium reserves and requirements, uranium marketing activities, and the enriched uranium market are discussed. There is an adequate supply of uranium to meet short-term needs for nuclear power plants, but the supply is uncertain for the long term. By the end of the century and the annual U. S. demand for concentrates and separative work could increase, respectively, to 8 and 6 times the past peak level. Between now and the year 2000 a capital investment of $9 billion is likely for new enriching plants just to meet U. S. requirements; a much higher investment would need to be made for different assumptions on tails assay for enrichment plants and the date of commercial introduction of breeders. (DHM)

5519 CRYSTAL CHEMISTRY OF URANYL PHOSPHATES ARSENATES (TYPE OF METATORBERNITE). Moroz, I. Kh.; Valueva, A. A.; Sidorenko, G. A.; Zhil'tsova, I. G.; Karpova, L. N. Geokhimiya; No. 2, 210-223(Feb 1973). (In Russian).

The synthesis of H-metaotenite has been carried out under various physicochemical conditions. Some polymorphic modifications have been obtained which are distinguished by the sizes and symmetry of the unit cells, their physical and optical properties and chemical composition being equal. (auth)

5520 URANIUM DISTRIBUTION IN HYPERBASITES OF THE INDIAN OCEAN RIFT ZONES. Komarov, A. N.; Zhitkov, A. S.; Dmitriev, L. V.; Leonova, L. L. Geokhimiya; No. 2, 304-309(Feb 1973). (In Russian).

The U and Th contents of hyperbasites of the Indo-oceanic ridge were determined as ranging between (0.06 to 1.20) × 10^{-6} g/g and (0.10 to 0.21) × 10^{-6} g/g, respectively, for nine samples. U determinations were made by luminescent and neutron activation methods, and Th was determined by colorimetry with Arsenazo III. Radiographic data on U were also obtained by fragment radiography; obtaining much smaller values in general (0.003 × 10^{-6} g/g as compared to 0.210 × 10^{-6} g/g). Uranium mineralization is discussed in terms of autometamorphism and hydrothermal activity. (KSW)

5521 GEOCHEMICAL STUDIES OF URANIUM, MOLYBDENUM, AND VANADIUM IN A SWEDISH ALUM SHALE. Armands, G. (Univ. of Stockholm). Stockholm Contrib. Geol.; 27: No. 1, 1-148(1972).

Factor analysis for uranium reveals a complex picture in which several, i.e. at least four, element and mineral combinations are prominent: Uranium, sodium, potassium, K-feldspar. In addition, rubidium and nickel, where uranium possibly is diadochically bound to authigenic K-feldspar of adularia type. Uranium can possibly substitute sodium in the crystal structure. Uranium appears together with the detrital minerals zircon, titanite and phosphorite. Possibly, the phosphorite is authigenic. Uranium is associated with organic carbon, vanadium, molybdenum and phosphorus probably occur as uranyl humates. Uranium is associated with sulfur. Most of the uranium present, as well as vanadium and molybdenum, probably formed alkali salts of the type sodium uranyl humate. Leaching tests, both acid and carbonate, generally indicate that the major part of the uranium in alum shale from Billingen is present today as dispersely distributed x-ray amorphous uranium oxide or to a smaller degree is bound to phosphorite and organic materials. Silicate-bound uranium is of subordinate importance. Alum shale from Billingen, Västergötland, shows a higher uranium content than the alum shale from Närke because the former originally contained more organic matter of humic origin. (SW)

5522 REJOINDER FROM GOESTA ARMANDS. Armands, G. (Univ. of Stockholm). Geol. Foren. Stockholm Forh.; 94: No. 3, 473-474(30 Sep 1972).

Goesta Armands gives an answer to Gee's comment on his article "A uranium-bearing layer from the lower ordovician, Sweden." The following subjects are treated: automatic recording of gamma radioactivity by car in northern Sweden, which led to discovery of the Taasjoe deposits, classification and nomenclature of these uranium-bearing layers, and the genetic origin of the uranium. (SW)

5523 GEOCHEMICAL PECULIARITIES OF MOLYBDATE AND URANOMOLYBDATE FORMATION IN THE ZONE OF HYPERGENESIS. Skvortsova, K. V.; Zhil'tsova, I. G.; Karpova, L. N. Geokhimiya; No. 4, 595-602(Apr 1973). (In Russian).

Results of the mineralogical and experimental study of geochemical peculiarities of molybdates, uranomolybdates, and their associations with other minerals are considered. Four associations of hypergene minerals differing in formation conditions are singled out. (auth)

Radioactive Effluents

Refer also to abstracts 5506, 5537, 5563, 6463, 6465, 6466, 6472, and 7616.

5524 (BNWL-CC-815) SOIL-CALCITE-STRONTIUM RELATIONSHIPS. Ames, L. L. Jr.; Hajek, B. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab). 6 Sep 1966. Contract AT(45-1)-1830. 18p. Dep. NTIS $3.00.

The behavior and significance to Hanford of the strontium-calcite adsorption mechanism is discussed. After determining that statistical analysis of factorially designed soil experiments involving removal of cesium and strontium radioisotopes by soil from simulated waste solutions was feasible, further work using a different soil showed an unusual and hitherto unknown relationship between strontium removal and soil calcite ($CaCO_3$). In one case, a noncalcareous (no $CaCO_3$) Burbank soil was used, and in the other case the same soil but calcareous. The strontium distribution coefficient (SrK_d) was used as the dependent variable. None of the effect totals were statistically significant when the surface soil was used, but the calcareous subsoil showed three significant effect totals. The three effect totals represent those for HNO_3 main effect, Ca^{2+} main effect, and a Ca^{2+}-HNO_3 interaction. The strontium K_d differences between surface and subsoil were quite large. Since many Hanford subsoils are calcareous, the relationship between soil calcite content and strontium removal was investigated further using ^{85}Sr and ^{137}Cs solutions and soil columns, with the activity distribution in the soil columns measured using scintillation scanner. The preliminary small and large column results showed that the use of presently available soil ion exchange models to predict strontium loading and distribution in soil columns during waste water disposal to the ground is probably satisfactory for most waste solutions. (CH)

5525 (CONF-730503-4) METHODS OF ESTIMATING DOSE TO MAN FROM REGIONAL GROWTH OF NUCLEAR POWER. Cowser, K. E.; Booth, R. S.; Fish, B. R.; Siegel, G. R.; Snyder, W. S.; Wilkie, W. H.; Witherspoon, J. P. (Oak Ridge National Lab., Tenn.). 1973. 18p. (SM-172/41). Dep. NTIS $3.00.

From symposium on environmental behavior of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973).

In cooperation with the United States Atomic Energy Commission

(USAEC), the Oak Ridge National Laboratory (ORNL), the Tennessee Valley Authority (TVA), the Atmospheric Turbulence and Diffusion Laboratory-National Oceanographic and Atmospheric Administration (ATDL-NOAA), and the Hanford Engineering Development Laboratory (HEDL) have undertaken a joint study of the potential radiological impact of an expanding nuclear power economy on the Tennessee Valley Region (TVR). The TVR study involves an appraisal of the generation, management, and control of radioactive effluents from nuclear facilities in the region through the year 2000. Consideration is given to nuclear power requirements to year 2000 and sites for nuclear facilities, to radionuclides that may be released and their transport in air and water and concentration in terrestrial and aquatic systems, and to estimation and interpretation of potential dose to man. Modifications in HERMES (Hanford Engineering Regional Model for Environmental Studies) are discussed within the context of the uniqueness of the TVR and additions or improvements based on the initial application of HERMES. The data required by HERMES for the estimation of the dose to man from internal and external modes of exposure are tabulated. (CH)

5526 (DOCKET-408027-10) SEQUOYAH URANIUM HEXAFLUORIDE PRODUCTION PLANT. Environmental Report, Supplement 2. (Kerr-McGee Corp., Oklahoma City, Okla.). 18 Jan 1973. 94p. Dep. NTIS.

5527 (DPSPU-72-30-9) NUCLEAR OPERATIONS AND THE ENVIRONMENT: SAVANNAH RIVER PLANT. Bebbington, W. P. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Atomic Energy Div.). Jan 1973. Contract AT(07-2)-1. 24p. Dep. NTIS $3.25.

The storage of nuclear wastes at the Savannah River Plant and any effects of operation of the plant on the Savannah River are considered. The plant and its operations as they may affect the environment are discussed. Included in the booklet's topics are: the important characteristics of nuclear fission; some facts about SRP reactors and chemical separations plants, and the means used to ensure that they will not appreciably affect the environment; the amounts of radioactivity, heat, and chemicals released from SRP and the consequences of these releases; the environmental monitoring program that ensures that any effects of plant operations are known and understood; and the present condition and uses of the 300 square miles of plant site. (CA)

5528 (EUR-4937) RADIOACTIVE POLLUTION: ITS ELIMINATION. Vaccarezza, J. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Apr 1973. 89p. (In French). Dep. NTIS (U. S. Sales Only) $6.50. EUR. FB. 125.–.

The problems of radioactive pollution and its elimination are considered. The first chapter deals with the principal radiochemical methods for the determination of radionuclides; the second indicates the physicochemical laboratory methods employed for the selection of the type of treatment. The treatment of liquid waste of medium and high radioactivity is investigated in the third chapter. The fourth chapter deals with the treatment of concentrates. (auth)

5529 (NP-19706) OVERLOADING THE SEA WITH WASTE PRODUCTS. Walden, H. (Studiengesellschaft zur Foerderung der Kernenergieverwertung in Schiffbau und Schiffahrt E. V., Hamburg (West Germany)). 1972. 41p. (In German). Dep. NTIS (U. S. Sales Only) $4.25.

Disposal of waste products into the sea is discussed. Particularly emphasized are oil, organic oxygen-consuming substances, pesticides, anorganic wastes including heavy metals, heat, and solid material. Radioactivity is discussed with respect to fallout, fission products from nuclear power plants, ships using nuclear propulsion, and river influx from uranium minings. Rising levels of radioactivity in the North Sea are probably the result of discharges from a French reprocessing installation at Cherbourg and from Windscale. The level of radioactivity, however, lies far below the limits of ICRP. Means for prevention of overloading the sea with waste products are discussed as well as the various organizations that are concerned about the problem. (HBG)

5530 (UCRL-51345) NUCLEAR CHEMICAL COPPER MINING AND REFINING: RADIOLOGICAL CONSIDERATIONS. Tewes, H. A.; Levy, H. B.; Schwartz, L. L. (California Univ., Livermore. Lawrence Livermore Lab.). 23 Feb 1973. Contract W-7405-Eng-48. 35p. Dep. NTIS $4.00.

A preliminary radiological safety analysis of the proposed nuclear chemical mining and refining process for copper has been carried out. The method involves the fracturing of impermeable copper ore bodies by means of nuclear explosives and the in situ leaching of the fractured ore with water containing dissolved oxygen under relatively high hydrostatic pressure. The conditions existing in a typical nuclear chimney during such copper ore leaching are postulated. Exposure sources and paths, exposed populations, and dose levels are all discussed. Existing data were utilized in the formulation of this safety analysis, and conservative (i.e., worst case) assumptions were used where data was unavailable. Despite the upper limit formulation of hypothetical radiological exposures to members of the public, all such exposures were found to be far below (much less than 1% of) current radiation protection guides. (CH)

5531 (WASH–1526) UNDERGROUND NUCLEAR TESTING PROGRAM, NEVADA TEST SITE. Environmental Statement. (Atomic Energy Commission, Washington, D. C.). Apr 1973. 135p. Dep. NTIS $8.75.

This environmental statement covers all underground nuclear tests and preparations for tests of one megaton (1 MT) or less at the Nevada Test Site (NTS) during Fiscal Years 1974 and 1975. If earthmoving-type tests or tests of yields above 1 MT should be planned these will be covered by separate environmental statements. (TD)

5532 CRITICAL PATHWAYS AND DERIVED WORKING LIMITS. Morley, F. (National Radiological Protection Board, Harwell, Eng.). pp 92-100 of Disposal of Radioactive Waste. Paris; Organisation for Economic Co-operation and Development (1972). (In French and English).

From meeting on disposal of radioactive waste; Paris, France (12 Apr 1972). See CONF-720453–.

Assessments of radioactive waste disposal operations involve the combination of knowledge of the behaviour of radioactive materials in the environment with the principles of radiological protection. The object of such assessments is to establish what radiation doses will be received by members of the public as a result of some defined release of radioactivity to the environment. If these doses can be established they can be compared with the basic dose limits recommended by ICRP, and this comparison will help those who must judge whether or not the release is acceptable. The principles of assessment and the basic standards and derived limits, based on dose, are discussed. Examples for releases of effluents to the atmosphere and water are given. The applications of derived working limits in control and monitoring are reviewed using the concept of critical pathway. (ERB)

5533 EXAMPLES OF WORKING LIMITS FOR DISCHARGES OF RADIONUCLIDES TO ATMOSPHERE. Bryant, P. M. (National Radiological Protection Board, Harwell, Eng.). pp 101-110 of Disposal of Radioactive Waste. Paris; Organisation for Economic Co-operation and Development (1972). (In French and English)

From meeting on disposal of radioactive waste; Paris, France (12 Apr 1972). See CONF-720453–.

The methods used to obtain representative values for the steps along pathways that start with the discharge of radionuclides to atmosphere and end with doses to members of the public are described. The spread of radionuclides in the atmosphere is estimated, and the pathways of some nuclides (^{131}I, ^{85}Kr, tritium, ^{90}Sr, ^{129}I) are illustrated. The methods for estimating possible air, water, and milk contamination are presented, and some typical derived working limits for discharges from stacks are given. (ERB)

5534 CRITICAL PATH ANALYSIS APPLIED TO THE CONTROL OF RADIOACTIVE WASTE DISPOSAL TO AQUATIC ENVIRONMENTS. Preston, A. (Ministry of Agriculture, Fisheries, and Food, Lowestoft, Eng.). pp 121-134 of Disposal of Radioactive Waste. Paris; Organisation for Economic Co-operation and Development (1972). (In French and English)

From meeting on disposal of radioactive waste; Paris, France (12 Apr 1972). See CONF-720453–.

The complex interaction of the many factors that have to be considered when evaluating safe rates of disposal for radioactive materials to the environment are discussed in relation to the problems encountered in aquatic environments, especially in estuaries and coastal waters. Critical path analysis, i.e. dilution, dispersion, reconcentration, and exposure, is applied to the control of radioactive waste disposal to aquatic environments. Methods for the derivation and use of derived working limits as they apply to aquatic environments are discussed. (ERB)

5535 HEALTH IMPLICATIONS OF THE DISPOSAL OF RADIOACTIVE WASTES AND WASTES FROM OTHER SOURCES.

Shalmon, E.; Chanteur, J. (World Health Organization, Geneva). pp 205-223 of Disposal of Radioactive Waste. Paris; Organization for Economic Co-operation and Development (1972). (In French and English)

From meeting on disposal of radioactive waste; Paris, France (12 Apr 1972). See CONF-720453-.

The sources of nonradioactive pollution are discussed in relation to their effects on the air, water, and land environments. The health implications of radioactive wastes are discussed under the following headings: sources and characteristics of wastes; radionuclides of global importance (tritium, iodine-129, and krypton-85); health effects of radioactive contamination (genetic and somatic effects); impact on man and his environment resulting from operating nuclear plants; and the role of health authorities. (ERB)

5536 ENVIRONMENTAL RADIOACTIVITY EVALUATIONS AT NUCLEAR ESTABLISHMENTS. Ito, N. (Japan Atomic Energy Research Inst., Tokai). Kuki Seijo; 10: No. 2, 11-15 (Jun 1972). (In Japanese).

Safety problems in the environment surrounding nuclear establishments are divided into two main items, effect of radioactive gases or minute particles released into the atmosphere and influence of radioactive liquid discharged into rivers and seas. It is necessary that evaluation is carried out by discriminating the effect under normal and emergent conditions. Radioactive nuclides, exposure route, and exposed groups, which play a crucial role in the exposure processes of surrounding public, are usually named critical nuclides, critical pathway, and critical groups. External exposure to a radioactive cloud and internal exposure caused by respiratory intake are considered. A diffusion equation to estimate leeward concentration of radioactive gases and an equation of γ-ray exposure to the radioactive cloud are given. The equations for the one day intake of the radioactive nuclides and permissible limit of that intake per man per day are indicated, concerning exposure caused by radioactive waste liquid. (Japan)

Radioactivity Monitoring and Transport

Refer also to abstracts 5189, 5533, 5590, 5594, 5762, 6469, and 7616.

5537 (AECL-4451) BIOLOGY AND HEALTH PHYSICS DIVISION PROGRESS REPORT, OCTOBER 1-DECEMBER 31, 1972. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Mar 1973. 107p. (PR-B-96). Dep. NTIS (U. S. Sales Only) $7.50. AECL $2.00.

Studies in the fields of biochemistry and molecular biology included the following research projects: effects of radiosensitizing agents on Escherichia coli; radioinduced degradation of DNA in E. coli; repair of radiation damage in Micrococcus radiodurans and Schizosaccharomyces pombe; and effects of gamma and ultraviolet radiation on DNA and protein synthesis in yeast. Genetic studies included the following projects: repair of spontaneous and radioinduced mutations in yeast; genetic control of radiosensitivity and dark repair in yeast; and radiation genetics of Dahlbominus and biting flies. Studies in the field of population research included the following projects: low-dose effects in fish embryos from irradiated sperm; chromosome cytology of irradiated fish; synergistic effects in radiation carcinogenesis; and use of hospital records and birth and marriage records for deriving human data on diseases likely to be increased by irradiation. Environmental research projects included surveys of effluents in the Ottawa River from the CRNL plant; geophysical, hydrological, and ecological explorations of Perch Lake Basin; ^{60}Co and ^{90}Sr in Perch Lake Basin; and effects of thermal effluents from the Gentilly reactor on organisms in the St. Lawrence River. Health Physics studies included thermoluminescence dosimetry at CRNL; neutron dosimetry studies; tritium monitoring of air and water in environs of reactors; development of a hand and foot monitor using large area thin window GM counters; and use of self-luminous digital outputs in development of monitoring instruments. (HLW)

5538 (BNWL-1727) ENVIRONMENTAL SURVEILLANCE AT HANFORD FOR CY-1972. Bramson, P. E.; Corley, J. P. (Battelle Pacific Northwest Labs., Richland, Wash.). Apr 1973. Contract AT(45-1)-1830. 76p. Dep. NTIS $3.00.

The 1972 Hanford Environmental Surveillance Program showed continued compliance of the Hanford contractors and their operations with applicable environmental standards. Samples of surface water, groundwater, air, foodstuffs, soil, and vegetation were collected and analyzed for radioactivity. Columbia River water also received chemical and biological analysis. Additionally, measurements were made of river immersion exposure rate, surface exposure rate (1 meter above soil surface), and radionuclide deposition on soil surfaces and highways open to public access. The shutdown of the last of the single-pass cooled production reactors (KE) in January of 1971 eliminated the major remaining source of population exposure from Hanford operations. In 1972 the average river radionuclide concentrations were less than 1% of the Concentration Guides for all identified radionuclides. Unidentified alpha emitters were 2.2% of which about 0.4% was due to Hanford operations. Biological and chemical measurements indicated an addition of coliform organisms (7% of standard) and BOD (no standard) between measurement points, which was due to non-plant sources. There was no measurable contribution to nitrate. Maximum river temperature was 19.6°C (less than the 20°C standard) and there was a net decrease in river temperature, on the average, between Priest Rapids and Richland. Average radionuclide concentrations in Richland sanitary water were less than 1% of the Concentration Guides except for unidentified alpha emitters, which was about 2.4%. As indicated above, most of the alpha activity does not originate from Hanford operations. Nitrate and fluorides in Richland sanitary water were 3 and 12% of the standards, respectively. Detailed analytical data on which this evaluation is based were published as a separate report (BNWL-1727 ADD). (auth)

5539 (CONF-730503-2) ASSESSING POTENTIAL RADIOLOGICAL IMPACTS TO AQUATIC BIOTA IN RESPONSE TO THE NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) OF 1969. Kaye, S. V. (Oak Ridge National Lab., Tenn.). 1973. 14p. Dep. NTIS $3.00.

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en Provence, France (14 May 1973).

Assessments of impacts for nuclear power stations sited near bodies of water receiving reactor effluents indicate that aquatic biota may receive higher doses than do terrestrial biota and that potential doses due to internal deposition of radionuclides may be several hundred times greater than potential external doses from immersion in contaminated water. Estimated doses are listed in each environmental impact statement for aquatic plants, invertebrates (crustaceans and molluscs), and fish. Where appropriate, doses are also estimated for waterfowl, shore birds, or muskrats. A steady-state bioaccumulation factor (concentration of radionuclide in biota/concentration of radionuclide in water) is used to estimate the body burden of each radionuclide for calculating internal dose. In most cases, site specific bioaccumulation factors are not available, and literature values, which usually cover a wide range, must be considered for the calculations. The radionuclides released from water-cooled reactors to the aquatic system differ from plant to plant, depending upon the type of radioactive waste cleanup system, but the most important dose-contributing radionuclides are usually ^{134}Cs and ^{137}Cs. Radionuclides of lesser importance are ^{58}Co, ^{60}Co, ^{90}Sr, ^{91}Sr, and ^{54}Mn. Although some uncertainty exists in the calculated potential doses, the upper limit doses to fish and invertebrates calculated under the most pessimistic assumptions usually do not exceed a few rems per year. Evaluation of the doses calculated thus far suggests that no biological effects of irradiation will likely be detected in the aquatic biota and that the radiological impact to the biota is likely to be trivial compared to potential effects from impingement of fish on water intake structures, from entrainment of fish and other aquatic organisms in condenser cooling water, and from temperature increases the biota experience in the receiving waters. (auth)

5540 (CONF-730503-3) RELATIVE RADIOLOGICAL IMPORTANCE OF ENVIRONMENTALLY RELEASED TRITIUM AND KRYPTON-85. Rohwer, P. S. (Oak Ridge National Lab., Tenn.). 1973. 16p. (SM-172/76). Dep. NTIS $3.00.

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en Provence, France (14 May 1973).

Simple comparison of air concentrations of HTO and ^{85}Kr with their respective maximum permissible concentrations does not provide a good indication of their relative radiological importance. Detailed considerations for each radionuclide emphasize differences which influence radiotoxicity. Dose estimates are presented, and the associated risks are compared for equal radionuclide concentration in air: somatic risk (HTO ~10X ^{85}Kr) and genetic risk (HTO ~50X ^{85}Kr). For populations in close proximity to the facility, ^{3}H will probably be the most significant dose contributor if nearly equal quantities of the two radionuclides are released. When projected radionuclide production and release figures are considered, the relative radiological impacts appear to be more nearly equal on a local basis for some facilities. However, in the latter case it is predicted that ^{85}Kr will contribute the greater dose to the global population. (auth)

5541 (DOCKET-50201-141) WEST VALLEY REPROCESSING PLANT. Quarterly Report, January 1, 1973–March 31, 1973. (Nuclear Fuel Services, Inc., West Valley, N. Y.). 17 Apr 1973. 8p. Dep. NTIS $3.00.

Data from environmental monitoring of low-level liquid effluents and gaseous effluents and surveillance tests at West Valley Reprocessing Plant for January 1, 1973 to March 31, 1973 are presented. (DHM)

5542 (EUR-4944) ENVIRONMENTAL RADIOACTIVITY: ISPRA, 1971. de Bortoli, M.; Gaglione, P. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Apr 1973. 48p. Dep. NTIS (U. S. Sales Only) $4.50. EUR B. Fr. 60.-.

The 1971 activity of the site survey group of the Protection Division at the Euratom Joint Research Centre-Ispra Establishment is reported. The group works on the radiation protection of the population concerned by the radioactive effluents of the Establishment. Results of measurements carried out directly on the effluents as well as in the environment in order to assess the contribution by the Establishment to the population dose and the pre-existing radiation and contamination levels of natural origin and those due to world-wide fallout are reported. The results of the determinations carried out in the field of nonradioactive pollution are also reported. (auth)

5543 (HEDL-SA-507) MODELING THE REGIONAL TRANSPORT OF RADIONUCLIDES IN A MAJOR UNITED STATES RIVER BASIN. Fletcher, J. F.; Dotson, W. L.; Peterson, D. E.; Betson, R. P. (Hanford Engineering Development Lab., Richland, Wash.). 1973. Contract AT(45-1)-2170. 26p. (CONF-730503-1; SM-172/40). Dep. NTIS $3.50.

From symposium on environmental behavior of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973).

A comprehensive study of the radiological implications of large-scale use of nuclear power generation, addressed to the Tennessee-Cumberland river basins in the Year 2000, is being undertaken jointly by the United States Atomic Energy Commission and the Tennessee Valley Authority, with participation by the Hanford Engineering Development Laboratory (HEDL), the Oak Ridge National Laboratory (ORNL), and the Atmospheric Turbulence and Diffusion Laboratory (ATDL). A computer model, HERMES, developed to permit evaluation over a large region of the relationships involving the release of radionuclides from operating nuclear facilities, the transport of these radionuclides into the environment, and the resulting dose to the population of the region is being used. The air and water transport codes ARTRAN and WTRAN, used in the HERMES model, are designed to simulate the movement of radionuclides from their points of release at a large number of plant sites, and to evaluate the resulting patterns of radionuclide concentration in the air, on the ground, and in the surface and ground waters and sediments. The ARTRAN and WTRAN codes have been modified for use with the diverse topography of the Tennessee Valley Region, and the consequent complexities in meteorological and streamflow conditions. The HERMES model, and particularly the transport codes ARTRAN and WTRAN, are designed to handle massive amounts of data and to provide results of accuracy consistent with that required for regional evaluations three decades in the future. Auxiliary codes are available to provide more detailed results close by specific sites. Using the present structure of the code, calculations may be made for up to 50 radionuclides, 200 release points, and 300 receptor locations. (CH)

5544 (PROT.-SAN.-11/71) DATA ON ENVIRONMENTAL RADIOACTIVITY COLLECTED IN ITALY (JANUARY–DECEMBER 1970) (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Oct 1971. 249p. Dep. NTIS (U. S. Sales Only) $14.50.

Data are presented for national networks, local networks, and isolated stations. The following national network data are tabulated: gross beta activity in the air at ground level; ^{90}Sr, ^{89}Sr, ^{137}Cs, ^{95}Zr, and ^{239}Pu content of fallout samples; ^{137}Cs and ^{90}Sr content of fresh water, irrigation water, drinking water, seawater, milk, bread, beef, fish, molluscs, and vegetables. Local network data are tabulated for gross beta activity in environs of nuclear power plants; ^{137}Cs and ^{90}Sr content of water, milk, plants, and fish at Ispra; and ^{137}Cs and ^{60}Co in bottom sediments at Ispra. Data are tabulated for isolated stations with regard to gross beta activity in the air at ground level, gross beta activity deposited by fallout and rain, and gross beta activity in water. (HLW)

5545 (TID-3337) MONITORING, CONTROL, AND DISPOSAL OF TRITIUM. A Selected Bibliography. (Technical Information Center (AEC), Oak Ridge, Tenn.). May 1973. 103p. Dep. NTIS $5.45.

References to 351 publications that have appeared in Nuclear Science Abstracts Volume 21 (1967) through Volume 26 (1972) are presented. Subject, author, corporate author, and report number indexes are also included. (DHM)

5546 ATMOSPHERIC RELEASES FROM TARAPUR. Abraham, P.; Pattnaik, D.; Paramesvaran, S. (Bhabha Atomic Research Centre, Bombay). Indian J. Environ. Health; 13: No. 3, 171-181(Jul 1971).

The safeguard features engineered into the Tarapur Atomic Power Station, India, to minimize, control and monitor the atmospheric pollutants from the station are described. The limits prescribed for the effluents from the station are discussed. The gamma spectra of the effluents are presented and the radioactive isotopes are identified. The major constituents of the gaseous waste are found to be isotopes of Xe and Kr. Data on actual releases are tabulated. The maximum value of activity i.e., 98, 500 μc/sec released at the station is very much less than the maximum value permissible release (580,000 uc/sec) prescribed by ICRP. Results obtained from the environmental monitoring stations are discussed. (auth)

5547 RADIOBIOASSAY PROGRAM OF THE INSTITUTIONAL TOTAL DIET SAMPLING NETWORK. III. Cesium-137 Dose Estimates and Body Burdens of Children. Moghissi, A. A.; Mayes, M. G. (National Environmental Research Center, Las Vegas, NV). Radiat. Data Rep.; 14: No. 4, 233-236(Apr 1973).

Food and urine samples collected from ten stations of the Institutional Total Diet Sampling Network program were analyzed. Cesium-137 and potassium in food and urine were analyzed by gamma spectroscopy. The cesium-137 body burdens were established by using the cesium-to-potassium ratio, by the relationship between cesium content of urine and the biological half-life of cesium in children, and by a model based on intake. Differences among results obtained, using each of these techniques, are discussed. Radiation dose calculations are based on recommendations in International Commission on Radiation Protection Report Number 2. (auth)

5548 DATA. Section IV. Other Data. Radiat. Data Rep.; 14: No. 4, 267-271(Apr 1973).

Results from routine sampling of biological materials and other media not reported in the previous sections are given. Included are such data as those obtained from human bone sampling, Alaskan surveillance, and environmental monitoring around nuclear facilities. (auth)

5549 RADIOBIOASSAY PROGRAM OF THE INSTITUTIONAL TOTAL DIET SAMPLING NETWORK. II. Selected Physiological Constants of Urine. Moghissi, A. A.; Mayes, M. G. (National Environmental Research Center, Las Vegas, NV). Radiat. Data Rep.; 14: No. 4, 225-232(Apr 1973).

The Institutional Total Diet Sampling Network program, initiated in 1961, has provided information on the intake of certain radionuclides by selected groups of children and young adults, and the resulting radiation dose. Starting with 1966, this was supplemented by a radiobioassay program with the aim of improving radiation dose estimates by using excretion data. Numerous physiological parameters were measured to evaluate their suitability for the validation of a 24-hour urine sample. The results of measurements of volume, specific gravity, pH value, osmolality, and creatinine in samples collected during 1966–1968 are summarized. Results of these measurements, along with a review of available data, with particular emphasis on creatinine, are presented and discussed. (auth)

5550 DATA. Section IV. Other Data. Radiat. Data Rep.; 14: No. 3, 213-224(Mar 1973).

Results from routine sampling of biological materials and other media not reported in the previous sections are given. Included here are such data as those obtained from human bone sampling, Alaskan surveillance, and environmental monitoring around nuclear facilities. (auth)

5551 STATE ENVIRONMENTAL RADIOACTIVITY SURVEILLANCE PROGRAMS, 1972. Culliton, M. A. (Environmental

Protection Agency, Washington, DC). Radiat. Data Rep.; 14: No. 3, 145-173(Mar 1973).

A summary of State environmental radioactivity surveillance programs for 1972 is presented. Information is given in table form on sample media, sites, collection and analysis frequency, and types of analysis performed. (auth)

5552 STUDY GROUP REPORTS ON NUCLEAR SAFETY AND ENVIRONMENT. At. Jap.; 16: No. 8, 14-16(Aug 1972).

The Study Group on Nuclear Safety and Environment, set up by the Japan Atomic Industrial Forum (JAIF), has produced an interim report on the discussion held over three months. The gist of JAIF's recommendation to be presented to the Government is summarized as follows. A Specialist Committee on the Examination of Reactor Environment should be set up to work on environmental questions as a part of the Atomic Energy Commission side by side with the Committee on the Examination of Reactor Safety. Conclusions arrived at by this new committee should be put to overall examination by the AEC. For this purpose, a special officer should be appointed among AEC members to take charge of safety review, and an Atomic Energy Examination Council should be organized to assist this officer. Since the Committee on the Examination of Reactor Environment must handle business related to the functions of different government agencies, and must be responsible for delicate coordination and collection of abundant data, it is necessary for the committee to have an environment study group and a coordination secretariat to assist its work. It is recommended that public hearings be held under the appropriate rule to be established and in cooperation with the central and local governments. The government should take proper measures to meet the need for monitoring structure centering on the local governments, so that radiation level can be checked independent of utilities and objectively, in order to increase credibility of radiation monitoring in the neighborhood of nuclear installations. (Japan)

5553 ENVIRONMENTAL RADIATION DOSIMETRY FOR NUCLEAR FACILITIES AND PROBLEMS. McLaughlin, J. E.; Beck, H. L. (Atomic Energy Commission, New York). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 36-42(Feb 1973).

The new interest in determining small changes in environmental radiation levels as evidenced by the establishment of as low as practicable numerical criteria indicates a need for reliable low-level radiation measurements. Though the expected contributions from routine operation of nuclear facilities are small compared to existing contributions to dose from natural radioactivity, cosmic radiation and fallout, monitoring programs should be modified to document actual levels and improve public relations as originally suggested by the ICRP. The relative value of instantaneous environmental exposure rate measurements and continuous monitoring is described. Model experiments, some by the Health and Safety Laboratory, are being performed to establish the ranges of validity of dose assessment calculations and improve monitoring techniques. The importance of studies of background variations, trends in long-term additions to the environment, and pathway-to-man analyses is described. (auth)

Atmosphere

Refer also to abstracts 5212, 5498, and 5536.

5554 (DOCKET-50268-43) MIDWEST FUEL RECOVERY PLANT. State of Illinois to Maintain Monitoring Services in Illinois. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 8 Nov 1972. 2p. (DOCKET-701308-2). Dep. NTIS $3.00.

5555 DATA. Section III. Air and Deposition. Radiat. Data Rep.; 14: No. 3, 202-212(Mar 1973).

Data are presented on the gross β radioactivity in surface air and precipitation in the United States and Canada and in the surface air of California and Central and South America during November 1972. Data are also presented on the ^{238}Pu and ^{239}Pu contents of airborne particulates at selected sites in the United States during July through September 1972. (ERB)

5556 DATA. Section III. Air and Deposition. Radiat. Data Rep.; 14: No. 4, 256-265(Apr 1973).

Data are presented on the gross β radioactivity in surface air and precipitation samples collected in the United States and Canada during December 1972. Data are also presented on the gross β radioactivity in surface air samples collected at selected sites in Central and South America, in California, and at selected sites on the Air Surveillance Network in the western United States during December 1972. All data are presented in tabular form. (ERB)

5557 RADIOAKTIVNYE IZOTOPY I GLOBAL'NYI PERENOS V ATMOSFERE. (Radioactive Isotopes and Global Transport in the Atmosphere). Karol, I. L. Leningrad; Gidrometeoizdat (1972). 368p.

The problem of nuclear meteorology, the use of radioactive tracers for the general circulation and global transport research in the troposphere and lower stratosphere, is considered. The first four chapters present a review and analysis of observed concentration fields of natural and artificial radioactive isotopes and global distributions of the climatic characteristics of meteorological factors that form these fields. A quantitative model of aerosol transport and removal in the planetary troposphere and stratosphere is constructed and several model parameter values are determined. In the last four chapters, the method and results of electronic computer calculations of the distribution of averaged concentration of natural isotopes and products of nuclear explosions up to 25 km level are presented, their time and space changes are studied. Some properties of macroturbulent and ordered transport in various parts of the atmosphere are revealed and general features of the global dispersion from the instantaneous local sources in the stratosphere are found. The book is addressed to meteorologists and to the experts in environmental radioactivity and nuclear safety. (auth)

Soil

5558 OBSERVATIONS ON LAKE SEDIMENTS USING FALLOUT ^{137}Cs AS A TRACER. Pennington, W. (Freshwater Biological Association, Ambleside, Eng.); Tutin, T. G.; Cambray, R. S.; Fisher, E. M. Nature (London); 242: No. 5396, 324-326(30 Mar 1973).

It would be expected that a continuously accumulating lake sediment would incorporate fallout ^{137}Cs with a distribution pattern similar to that found from regular analysis of rain and air-borne particulate matter, provided there has been no significant mixing in the sediment. In order to test this, lakes of the English Lake District were analyzed for ^{137}Cs using γ spectroscopy with Ge(Li) detectors. The distribution pattern in the top-most 25 cm. of sediment is shown for five lakes. It was found that ^{137}Cs was present in accordance with recorded annual variations in supply from rain, rather than by erosion from the cumulative deposit on the watershed, and there was strong evidence for the absence of significant vertical movement after the ^{137}Cs had reached the mud surface. Implications for sediment depth considerations and sediment accumulation rates are discussed—also the influence of eutrophication. (UK)

5559 RADIOACTIVE FALLOUT IN SOIL. Eriksson, A. (Institutionen foer Radiobiologi, Uppsala). Grundforbattring; 23: No. 5, 23-30(1970). (In Swedish).

Fallout after the nuclear weapon tests in 1961 and 1962, and the resulting intake with food and accumulation of ^{90}Sr and ^{137}Cs in the body of man during the following years, are considered. In the long term situation, after the cessation of fallout, the amounts of ^{90}Sr and ^{137}Cs deposited in the soil are the only source from which the crop can be contaminated. In this situation the characteristics of the soil determine the contamination levels of the crop products within wide limits. A higher ^{90}Sr/Ca-ratio in plants is obtained on soils with low cation exchange capacity and low calcium content than when these characteristics show higher values. A factor of 10 was observed for cultivated soils. A still larger variation has been found for the root uptake of ^{137}Cs. A factor of 50 was observed. The ^{137}Cs uptake is lowest on soils rich in clay and potassium, increases with decreasing content of clay and potassium, and reaches its highest value on organic soils. The fact that the main characteristics of the Swedish soils are relatively well known has made it possible to classify the different production areas with respect to the expected content of ^{90}Sr and ^{137}Cs in the crops at certain contamination levels of the plough layer. This work shows that the main part of our foods is produced in areas where they will obtain comparatively low contents of ^{90}Sr and ^{137}Cs after a fallout period. In some economic margin areas, however, the contamination level of the foods can be considerably higher, and this may give relatively higher internal radiation exposure to local groups of farmers who produce the greater part of their own food. (auth)

5560 TREATMENTS FOR FARMLAND CONTAMINATED WITH RADIOACTIVE MATERIAL. Agriculture Handbook No.

395. Beltsville, MD; Department of Agriculture (1971). 18p. GPO $0.20.

Information is presented on the effectiveness and feasibility of various treatments for farmland contaminated with radioactive material. Two kinds of treatments are evaluated. The first kind, which may be called decontamination, includes methods of removing radioactive material from farmland. The second kind includes methods of treating land to reduce the uptake of radioactive materials by crops without decontaminating. Alternatives to treating contaminated land are discussed to give a broader perspective on the techniques of managing contaminated land. Possible sources of radioactive material that could contaminate farmland include widespread fallout from the explosion of nuclear weapons, a very limited spread from a transportation accident involving radioactive material, and contamination from a very severe reactor accident, which might affect several hundred square miles. (CH)

Water

Refer also to abstracts 5223 and 5432.

5561 (CEA-R-4443) ROLE OF THE ORGANIC MATTER OF A WATERWAY WITH REGARD TO THE RADIOACTIVE POLLUTION. Faure, J. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Mar 1973. 53p. Dep. NTIS (U.S. Sales Only) $4.75.

Comparison between three methods of extraction using soda solutions with respective normalities of 10^{-1}, 10^{-2}, and 0.5 to 0.10^{-2} N reveals that the second one shows a degree of efficiency practically as high as the first one, whereas the third one is distinctly less efficient. Splittings obtained by gel chromatography seem to bear evidence of the degradation of the organic substances extracted by soda 10^{-1} N and ion-exchanger resins, which leads to the recommendation of the use of the solution 10^{-2} N. The various radioelements investigated, once brought in contact with the sediment, before extraction of the organic matters, allows the elements of the periodical classification to be divided into groups, according to their affinities for the organic substances of the sediment studied. Thus, the group formed by the transition elements seems to be the more reactive with regard to these substances. The elements of the other groups of the classification are less interesting with regard to the pollution studies concerning organic matter, which was foreseeable, owing to their weak possibility of complexation. (auth)

5562 (RLO-2225-T-20-9) RADIOCARBON IN THE SEA. Progress Report, May 1, 1972–May 1, 1973. Fairhall, A. W. (Washington Univ., Seattle. Dept. of Chemistry). 1973. Contract AT(45-10)-2225. 30p. Dep. NTIS $3.50.

Less than one-third of the ^{14}C deposited in the atmosphere during the 1961–62 nuclear tests remained in the atmosphere due to the air-sea exchange of CO_2 and less than one-third of the fallout ^{14}C taken up by the sea remained in the mixed layer of the sea (upper 85M±) during 1972, with the remaining two-thirds distributed in a decreasing fashion down the thermocline, where it was detected at depths of about 1000M in the Pacific Ocean. In contrast with ^{14}C, both advection and diffusion transport inorganic carbon up the thermocline. A model for the accumulation of fossil CO_2 in the atmosphere and in the sea is presented and discussed. (CH)

5563 BEHAVIOR OF RADIOACTIVITY IN THE MARINE ENVIRONMENT. Feldt, W. (Bundesforschungsanstalt fuer Fischerei, Hamburg). pp 69-79 of Disposal of Radioactive Waste. Paris; Organisation for Economic Co-operation and Development (1972). (In French and English)

From meeting on disposal of radioactive waste; Paris, France (12 Apr 1972). See CONF-720453–.

The distribution, reconcentration, and sedimentation of radionuclides deposited in the sea are discussed. These parameters vary for near shore and deep sea areas, however, there are some mechanisms basic to both environments. The concentration factor, biological transport, and adsorption on sediments are common phenomena that are defined and described. The radiobiological aspects of radioactivity in the marine environment and the criteria for site selection for disposal of radioactive wastes are also discussed. (ERB)

5564 MOLYBDENUM IN MARINE DEPOSITS. Bertine, K. K.; Turekian, K. K. (Yale Univ., New Haven). Geochim. Cosmochim. Acta; 37: No. 6, 1415-1434(Jun 1973).

The distribution and rates of accumulation of Mo in marine deposits have been determined and compared with the same parameters for U and Mn. The analytical methods employed were neutron activation analysis with radiochemical separation and emission spectrography monitored by the neutron activation results. All materials on which molybdenum values were obtained by neutron activation were also analyzed for uranium. High concentrations of Mo are associated both with oxidizing environments represented by the presence of ferro-manganese oxide-rich sediments (where Mo/U $\simeq$ 3) and with reducing environments (where Mo/U is about unity). The supply of Mo by streams is more than adequate to balance the measured removal rate in normal deep-sea deposits and no submarine volcanic "emanations" need be involved. On an ocean-wide basis, 4.3 μg Mo/cm^2/1000 yr is supplied in solution by streams. Of this, 2.0 μg Mo/cm^2/1000 yr is removed in deep-sea sediments and manganese nodules. The remaining 2.3 μg Mo/cm^2/1000 yr is probably removed in primarily but not exclusively) near-shore reducing sediments. The average Mo accumulation rate in these environments is about 1000 μg Mo/cm^2/1000 yr; thus only 0.23 per cent of the world ocean area need be such reducing sites. (auth)

5565 DATA. Section II. Water. Radiat. Data Rep.; 14: No. 4, 249-255(Apr 1973).

Data are presented on the gross α and β radioactivity in surface water samples collected from selected sites in the United States during October and November 1972. Data in the gross α and β radioactivity and tritium concentration in surface water samples collected from selected sites in California, Nevada, and Utah during October 1972 are also presented. All data are presented in tabular form. (ERB)

5566 DATA. Section II. Water. Radiat. Data Rep.; 14: No. 3, 189-201(Mar 1973).

Data are presented on the gross α and β radioactivity in surface waters of the United States during June through September 1972. Data are also presented on the gross α and β radioactivity and tritium content of surface waters in California, Nevada, and Utah during July to September 1972. All data are presented in tabular form. (ERB)

Ecosystems and Food Cycles

Refer also to abstracts 5525 and 6463.

5567 (RLO-2227-T-12-27) RADIOECOLOGY OF BENTHIC FISHES OFF OREGON, U. S. A. Pearcy, W. G.; Vanderploeg, H. A. (Oregon State Univ., Corvallis. Dept. of Oceanography). 1972. 24p. (SM-158/14). Dep. NTIS $3.25.

Gamma-emitting radionuclides were found in benthic fishes from depths of 50 to 2800 m off the Oregon coast from 1964 to 1971. ^{65}Zn, ^{60}Co, ^{54}Mn, ^{144}Ce, ^{137}Cs, and ^{40}K were present. Zinc-65, originating mainly from the nuclear reactors on the Columbia River, was the predominant artificially induced radionuclide. Levels of ^{65}Zn per g and specific activities of ^{65}Zn decreased markedly in several species of fishes between 1965 and 1971 because of the shutdown of reactors. This decrease was greater for small than large Lyopsetta exilis during 1970 to 1971. Specific activities decreased with increasing depth, both for individual species inhabiting broad depth ranges and for different species inhabiting different depths. Specific activities of ^{65}Zn were inversely related to body size for L. exilis and Sebastolobus. Other variations of ^{65}Zn were related to trophic position. Fishes that preyed on low trophic level pelagic animals had higher specific activities than fishes that preyed on benthic invertebrates. Such pelagic feeders may play an important role in accelerating the transport of some radionuclides or elements to the sea floor. (auth)

5568 (RLO-2227-T-12-37) DYNAMICS OF ^{65}Zn IN BENTHIC FISHES AND THEIR PREY OFF OREGON. Vanderploeg, H. A. (Oregon State Univ., Corvallis). Jun 1973. 114p. Dep. NTIS $7.75.

Thesis.

The dynamics of ^{65}Zn specific activity in the benthic fishes, Lyopsetta exilis and Microstomus pacificus, was studied. Seasonal patterns of ^{65}Zn in their major prey, annelids, crustaceans, and molluscs, were determined. Studies were also conducted on geographical patterns of ^{65}Zn specific activity in benthic fishes and their prey. (HLW)

5569 BEHAVIOR OF RADIOACTIVITY IN THE TERRESTRIAL ENVIRONMENT. Grauby, A. (CEN, Cadarache, France). pp 51-68 of Disposal of Radioactive Waste. Paris; Organisation for Economic Co-operation and Development (1972). (In French and English).

From meeting on disposal of radioactive waste; Paris, France (12 Apr 1972). See CONF-720453–.

Once radioactive products are discharged into the environment, transfer mechanisms occur immediately that give rise to dispersion of these polluting agents or to the inverse phenomenon of reconcentration. These transfer mechanisms that govern the cycle of radioactive products in the environment are dependent on many parameters that may be divided into three groups: those linked to the pollution source and to the method of disposal; those linked to the type and physico-chemical form of the radionuclides; and those linked to the natural environment proper. Because of the heterogeneity of the terrestrial environment, the transfer mechanisms for radionuclides become quite complex. Transfer mechanisms in the three principal constituents of the terrestrial environment, namely, water and the aquatic living environment, the ground, and crops and foodstuffs are discussed. (ERB)

5570 TRANSFER OF ^{90}Sr THROUGH FOOD CHAINS TO THE HUMAN DIET. Progress of Knowledge in the Last 15 Years. Scott-Russell, R. (Agricultural Research Council Letcombe Lab., Wantage, Eng.). pp 111-119 of Disposal of Radioactive Waste. Paris; Organisation for Economic Co-operation and Development (1972). (In French and English)

From meeting on disposal of radioactive waste; Paris, France (12 Apr 1972). See CONF-720453–.

The knowledge obtained over the past 15 years on the transfer of ^{90}Sr through food chains to the human diet is briefly reviewed. It has been determined that retention on leaves and basal parts of plant shoots, not root absorption, are the main source of ^{90}Sr in the human diet. Equations are developed to relate the annual average concentration of ^{90}Sr in milk to the rate of fallout and the cumulative deposit. The ^{90}Sr content in fallout and milk in the United Kingdom during 1958 to 1970 is presented in graphic form to illustrate the application of the equations derived. (ERB)

5571 RADIOBIOASSAY PROGRAM OF THE INSTITUTIONAL TOTAL DIET SAMPLING NETWORK. I. Analytical Data Related to Samples Collected During 1966–1968. Moghissi, A. A. (National Environmental Research Center, Las Vegas, NV); Carter, M. W.; Lieberman, R. Radiat. Data Rep.; 14: No. 3, 129-144 (Mar 1973).

In January 1966, a radiobioassay program was added to the Institutional Total Diet Sampling Network program. The sampling and analysis procedures are described and the data for 1966 through 1968 are presented. (auth)

5572 DATA. Section I. Milk and Food. Radiat. Data Rep.; 14: No. 3, 175-188(Mar 1973).

Data are presented on the milk surveillance activities of the Pasteurized Milk Network, Pan American Milk Sampling Program, and Canadian Milk Network during November 1972. The concentrations of ^{90}Sr and ^{137}Cs in milk samples collected during November 1972 and the 12-month average for December 1971 through November 1972 are presented in tabular form. Data on the ^{137}Cs, ^{89}Sr, ^{90}Sr, and tritium contents of milk samples collected by the Milk Surveillance Network in California, Utah, and Nevada during July to September 1972 are presented in tabular form. (ERB)

5573 DATA. Section I. Milk and Food. Radiat. Data Rep.; 14: No. 4, 237-248(Apr 1973).

Data are presented on the ^{90}Sr and ^{137}Cs concentrations in milk samples from the United States, Canada, and Central and South America. The samples were collected during December 1972. Average concentrations for the 12-month period ending in December 1972 are also given. Data on the ^{137}Cs, ^{89}Sr, ^{90}Sr, and tritium contents of milk samples from California, Nevada, and Utah are presented. The samples were collected during October 1972. All data are presented in tabular form. (ERB)

5574 RADIOAKTIVNYI IOD V PROBLEME RADIATSIONNOI BEZOPASNOSTI. (Radioactive Iodine in the Problem of Radiation Safety). Il'in, L. A. (ed.). Moscow; Atomizdat (1972). 272p.

Practically all the aspects of radioactive iodine are dealt with in this monograph: its occurrence in the environment, as a product of a nuclear explosion, and its migration in the biosphere. Quantitative relationships of iodine exchange in man's organism and its significance to the thyroid gland are elucidated. Radiation hazards of the isotopes 125, 127, 131, 132, 133, 134, and 135 of iodine, their dosimetry, controlled release into the atmosphere, accident prevention, and other health aspects are discussed. 676 references. (KSW)

5575 STUDY OF THE CONTAMINATION OF ARENICOLA MARINA L. (POLYCHAETE ANNELIA) WITH ^{60}Co. Triquet, C. (CEN, Fontenay-aux-Roses, France). Compt. Rend., Ser. D; 276: No. 4, 645-648(22 Jan 1973). (In French).

Three ways in which Arenicola marina L can be contaminated by ^{60}Co were considered: water, the sediment acting as a substrate, and organic matter of the sediment acting as food. It appears that water plays the most important role in the contamination process, the fraction of the radionuclide being fixed in the sediment being no longer available for animal life. The cobalt concentrates mainly in the digestive tract and the blood. (France)

Radiometric Techniques

Refer also to abstracts 5606 and 5625.

5576 (TID–26306) URANIUM SERIES DATING OF STALAGMITES FROM BLANCHARD SPRINGS CAVERNS, STONE COUNTY, ARKANSAS. Thompson, G. M. (Memphis State Univ., Tenn. (USA)). May 1973. 42p. Dep. NTIS $4.25.

Thesis.

Procedures for uranium-thorium and uranium disequilibrium dating of speleothems were developed, making use of alpha spectrometry for thorium determinations and mass spectrometry for uranium determinations. Thorium was removed from calcite in a three-step process using an anion exchange separation followed by LaF_3 precipitation, and thenoyltrifluoroacetone extraction. Uranium was separated from the calcite by extraction with tributylphosphate. The stalagmites tested were generally beyond the age range of the U–Th age dating method, and, as a result, $^{234}U/^{238}U$ ratios provided the most useful dating technique. Because stalagmites are enriched in ^{234}U beyond the equilibrium value at the time of deposition, they are potentially datable by measuring their progress toward equilibrium from their original state of ^{234}U enrichment, which can be inferred from the $^{234}U/^{238}U$ ratio of the present-day cave waters. Stalagmites that have been active over a long-time interval are required to make use of this dating technique. In this study, the age of a stalagmite from Blanchard Springs Caverns was shown to have developed during the period from 148,000 to 800,000 years BP with an interval of slow or suspended growth from 380,000 to 525,000 years BP. Stalagmites up to 1.5 million years old are potentially datable using this method. (auth)

5577 HELIUM–URANIUM DATING OF CORALS. Bender, M. L. (Columbia Univ., Palisades, NY). Geochim. Cosmochim. Acta; 37: No. 5, 1229-1247(May 1973).

Fanale and Schaeffer (Science; 149: 312-317 (1965)) determined He/U ages of corals and other aragonitic fossils, and found that the results generally agreed with independent age estimates. As a more extensive and rigorous test of the reliability of He/U ages of fossil corals, He/U ages have been determined on forty-five independently dated Cenozoic corals. Uranium and thorium isotope compositions and ^{222}Rn retentivities were also determined as consistency checks. The results indicate that reliable ages are obtained when the following consistency tests are met and the following corrections are made: corals are unrecrystallized aragonite; ^{232}Th is absent, indicating that the samples are free of contaminating detritus; $^{234}U/^{238}U$ and $^{230}Th/^{234}U$ ratios are concordant with the He/U age; ^{222}Rn leakage is less than 5 per cent; a correction is made for inherited helium; a correction is made for alpha particles "shot out" from the coral walls during U and U daughter decay. (auth)

5578 LOW-CONTAMINATION METHOD FOR HYDROTHERMAL DECOMPOSITION OF ZIRCONIUM AND EXTRACTION OF U AND Pb FOR ISOTOPIC AGE DETERMINATIONS. Krogh, T. E. (Carnegie Institution of Washington, DC). Geochim. Cosmochim. Acta; 37: No. 3, 485-494(Mar 1973).

A simple procedure for the decomposition of zircon and the extraction of U and Pb for isotopic age determinations has been developed and tested (Krogh, 1971). Samples are decomposed at 220°C with 48 per cent HF in a Teflon capsule confined by a self-sealing stainless steel jacket. Uranium and lead are isolated on a Teflon anion exchange column using Dowex 1 resin. Measured lead contamination levels range from 0.5 to 5.0 ng. In contrast, lead blanks for the borax fusion technique used in all previous zircon analyses are typically 0.2 to 1.0 μg. Eight small samples weighing 0.3 to 7 mg contained 30 to 250 ng of ^{206}Pb. The average value for the total amount of common lead present in the lead isotopic composition analysis, contributed from both the sample and the chemical procedures, was 1.4 ng. The highest $^{206}Pb/^{204}Pb$ ratio measured to date (126,000) was obtained on a

0.1-g sample that contained 50 ppM of ^{206}Pb. An exact determination of the amount of common lead in zircons is now possible. A maximum value of 0.3 ppM was found for fourteen nonmagnetic zircon fractions from granites and rhyolites. Higher values reported in the literature suggest that lead contamination levels are often underestimated in the analysis of zircons by the borax fusion technique. The silica-gel loading technique for lead provides stable emission for small samples as well as limited isotopic fractionation in the mass spectrometer. These features, combined with the low levels of lead contamination and the high precision of mass spectrometric analyses, make possible an average reproducibility (for duplicate decompositions of the same finely ground sample) of 0.3 M.y. for lead 207/206 ages of 2750 M.y. The new method requires fewer reagents and is much easier than the borax fusion technique. (auth)

5579 MEASUREMENT OF GROUNDWATER PARAMETERS AT KORGEN WATERWORKS, LILLEHAMMER, BY MEANS OF ISOTOPE TECHNIQUES. Dahl, J. B. (Institutt for Atomenergi, Kjeller, Norway); Haagensen, U.; Tollan, O.; Kirkhusmo, L. A.; Klemetsrud, T.; Oestmo, S. R. pp 67-108 of Nordisk Hydrologisk Konferanse 1972. Bind 1. Oslo; Nordisk Hydrologisk Forening (1972). (In Norwegian).

From Nordic hydrological conference 1972; Sandefjord, Norway (6 Sep 1972).

Isotope techniques were used to determine a series of ground water parameters of interest in connection with the planning and development of Korgen Waterworks, Lillehammer. Radioactive tracers combined with isotope measuring techniques were shown to be suitable in determining the velocity and direction of the flow of ground water at various depths. A new method was used to obtain the quantitative distribution of ground water drawn into a pumping well from various directions. Stable tracers and activation analysis were applied to determine the routes from which pollution could conceivably be brought into the ground water reservoir. (NO)

5580 TRITIUM MEASUREMENTS OF THE MURRUMBIDGEE RIVER AT WAGGA. Barnes, J.; Carswell, D. (Commonwealth Scientific and Industrial Research Organization, Deniliquin, Australia). J. Geol. Soc. Aust.; 19: No. 2, 225-227(Oct 1972).

Tritium was used to study water in the Murrumbidgee River over a fifteen month period. Comparison of the tritium content of the river at Wagga with river height fluctuations showed that the underground aquifers provide the main contribution to the river supply at low river levels. (auth)

5581 ISOTOPE STUDIES ON NITROGEN IN FOREST SOIL. 1. Relative Losses of Nitrogen Through Leaching During a Period of Forty Months. Overrein, L. N. (Norske Skogforsoeksvesen, Vollebekk, Norway). Medd. Nor. Skogforsoeksv.; 29: No. 5, 261-280(1971).

A lysimeter investigation was conducted over a period of 40 months to study the leachability of different forms of N in acid podzolic forest soil. The 40-cm-deep profiles, which maintained their natural stratification, were top-dressed with isotope ^{15}N-enriched solutions of urea, ammonium chloride, and potassium nitrate. The total leaching of N was on an average basis, in the order of 2, 23, and 90% of added N, within 3 months after adding urea, ammonium, and nitrate, respectively. The corresponding total losses of N through leaching, at the end of the 40-month period in question, were 25, 37, and 95%. The accumulated losses of tracer N within 40 months, expressed in percentage of added N were in the order of 0.1, 7, 11, and 30 in the 10, 25, 50, and 100 g N/m^2 urea treatment, respectively. The 10 and 25 g N/m^2 ammonium treatment resulted in losses of tracer N of about 3 and 17% of the added N, the corresponding figures in the nitrate treatment being 82 and 89%. Up to 90% of the total leached N in the urea-fertilized soil was recovered as nitrate at the end of the 40-month period. The pH of the leachates at various sampling times is an effect of the nitrogen carriers besides reflecting the form at which the N in the leachates was recovered. Urea seems to give rise to a more extensive downward movement of organic soil N than does the ammonium, and particularly the nitrate, treatment. (auth)

5582 ISOTOPE STUDIES ON NITROGEN IN FOREST SOIL. 2. Distribution and Recovery of ^{15}N-Enriched Fertilizer Nitrogen in a 40-Month Lysimeter Investigation. Overrein, L. N. (Norske Skogforsoeksvesen, Vollebekk, Norway). Medd. Nor. Skogforsoeksv.; 30: No. 4, 307-324(1972).

A lysimeter investigation on podzolic soil was conducted. The intention of the study was to elucidate the relative and quantitative distribution in soil and ground vegetation of N added as ^{15}N-enriched urea, ammonium, and nitrate. The data show a relatively strong retention of N added as urea, particularly in the raw humus layer. The ^{15}N thus retained in soil appears in a chemical structure not readily available to biological agencies. The ammonium application resulted in a fairly extensive downward movement of ^{15}N in the soil. The nitrate is characterized by only a minor retention in soil. Experimental evidence of the production of $^{15}N_2$ in urea-fertilized soil is given. The deficit in the N balance in the urea-treated soil is explained as being partly a result of spontaneously occurring chemical reactions between urea, or intermediate products from the hydrolysis of this amide, and specific groups in the humic structure. The ^{15}N data presented are considered from both the standpoint of plant nutrition and water pollution. (auth)

5583 GEOLOGO-RADIOLOGICHESKAYA INTERPRETATSIYA NESKHODYASHCHIKHSYA ZNACHENII BOZRASTA. (Geological Radiological Interpretation of Divergent Values of Age). Afanas'ev, G. D. (ed.). Moscow; Izdatel'stvo Nauka (1973). 415p.

This Russian language collection of 41 papers by various authors treats the subject of radioisotope ratio dating techniques used for geochronological investigations of geological samples collected in Eastern Europe. Studies of marine sediments are also reported. Methods are given for determining the absolute age of geological formations by measurements of ^{40}Ar-^{40}K ratio in samples. A bibliography of 799 references is appended representing Russian and foreign literature on age determination from 1968 to 1969. (KSW)

5584 EXPLANATION FOR LOW RADIOMETRIC AGES FROM GLAUCONITE. Thompon, G. R.; Hower, J. (Montana State Univ., Missoula). Geochim. Cosmochim. Acta; 37: No. 6, 1473-1491(Jun 1973).

K-Ar and Rb-Sr ages from glauconites are about 10 to 20% lower than the age of sedimentation. Previous studies indicated that these low ages are not attributable to normal diffusion loss of Ar from glauconite crystallites. The possibility of argon loss from "open" potassium sites, such as on crystal surfaces and from expanded layers, was investigated by acid dissolution techniques. These studies show that potassium is removed from glauconites with low expandabilities at three different rates. The highest dissolution rate corresponds to cation exchange and comprises 5 to 10% of the total potassium. About 5% of the total potassium is removed at a much slower rate than that of cation exchange, but at an order of magnitude faster than the bulk of the potassium. Activation energies calculated from rate constants determined at 50 and 80°C, for one sample gave values of 19 kcal/mole for the lowest dissolution rate and 14 kcal/mole for the intermediate rate. It appears that low radiometric ages from glauconites can be largely explained by the presence of potassium in sites where argon is readily lost, although such factors as late epigenetic gain of potassium by glauconite may also contribute to their low radiometric ages. A method is described for making quantitative corrections for such daughter product loss in radiometric age determinations. (auth)

Site Surveys

Refer also to abstracts 5497, 5499, 5531, 7535, and 7597.

5585 (DOCKET-701372-2) GULF YOUNGSVILLE NUCLEAR FACILITY. Environmental Impact Report, Addendum. (Gulf Energy and Environmental Systems, Inc., San Diego, Calif.). Feb 1973. 56p. (GULF-EES-A-12380(Add.)). Dep. NTIS $5.00.

An Addendum to the Environmental Impact Report of Gulf Youngsville Nuclear Facility is presented that considers joint distribution of wind speed, wind direction, and atmospheric stability by seasons from an analysis of data collected at the Raleigh-Durham airport over the period from January 1, 1960 to December 31, 1964. (DHM)

5586 (NP-19768) VEGETATION OF AMCHITKA ISLAND, ALEUTIAN ISLANDS, ALASKA. Geological Survey Professional Paper 648. Shacklette, H. T.; Durrell, L. W.; Erdman, J. A.; Keith, J. R.; Klein, W. M.; Krog, H.; Persson, H.; Skuja, H.; Weber, W. A. (Geological Survey, Washington, D. C.). 1969. 75p. GPO $1.00.

5587 (NVO-124) GEOLOGICAL INVESTIGATION OF THE BERING SEA FLOOR ADJACENT TO THE CANNIKIN DETONATION SITE ON AMCHITKA ISLAND, ALASKA. Humphrey,

T. M. Jr.; Branstetter, D. L. (Nevada Operations Office (AEC), Las Vegas). Feb 1973. 30p. Dep. NTIS $3.50.

In September 1972, the Office of Effects Evaluation, Nevada Operations Office, initiated underwater investigation of a geomorphic feature and tree remains previously noted by National Marine Fisheries Service divers. Island geology and the Cannikin event are briefly described. Goals, participants, investigative methods, and findings are reported. The geomorphic feature is concluded to be an elongated submerged sea stack, which contains well-preserved, recently exposed tree remains of probable Miocene age. Identification of the tree remains continues. (auth)

5588 (NVO-746-11) ALEUTIAN SEISMIC PROGRAM HYPOCENTER SUMMARY, APRIL-SEPTEMBER 1972. (National Oceanic and Atmospheric Administration, Las Vegas, Nev. Earth Sciences Labs.). Apr 1973. Contract AT(29-2)-746. 68p. Dep. NTIS $5.50.

Preliminary data acquired from an Aleutian network of seismograph stations are collected and distributed. Data analysis and hypocenter computation was performed by the Special Projects Party of NOAA/ESL in Las Vegas, Nevada. Seismicity of Amchitka Island and Vicinity maps were prepared to give a closer view of earthquakes occurring on or near Amchitka Island and to show any relation of earthquake occurrence with mapped faults or with the Cannikin GZ. (MCG)

5589 (NVO-746-12) PRELIMINARY SEISMICITY STUDY OF THE SOUTHERN NEVADA REGION. Quarterly Report, January-March 1973. (National Oceanic and Atmospheric Administration, Las Vegas, Nev. Earth Sciences Labs.). May 1973. Contract AT(29-2)-746. 131p. Dep. NTIS $8.75.

A cooperative (ESL, Sandia Laboratories, and USGS) network 21 seismic velocity sensitive stations is operated in the southern Nevada area; the stations are monitored by the NOAA/ESL Nevada Special Projects Party, located in Las Vegas, Nevada. The most active area during this period was in the Ranger Mountains/Frenchman Lake area on and adjacent to the Nevada Test Site (NTS). Six monthly seismicity maps are included; three of the southern Nevada region and three of the seismicity on and adjacent to the Nevada Test Site. (auth)

5590 (PNE-WW-24) ENVIRONMENTAL MONITORING REPORT: PERIOD COVERING AUGUST 1, 1972-OCTOBER 31, 1972. (Eberline Instrument Corp., Santa Fe, N. Mex. Dept. of Nuclear Sciences). 1972. 22p. Dep. NTIS $3.25.

For El Paso Natural Gas Co.

Beta radioactivity in air particulates in the environs of the Pinedale, Wyoming site proposed for gas stimulation by underground nuclear explosion (Project Wagon Wheel) ranged from 0.03 to 0.11 pCi/m^3. These levels are lower than for the previous quarter and indicate lower levels of worldwide fallout in the atmosphere. Gross beta in surface, municipal, and well water ranged from less than 2 to 9 pCi/l. The tritium concentration was less than 1 pCi/ml in all of these samples. Gross beta in precipitation was 1.0 ± 0.1 nCi/m^2 and the tritium concentration was less than 1 pCi/ml. The concentration of Sr-90 in milk ranged from 4.9 pCi/l at Lander to 23.2 pCi/l at Ranch #5. Although the milk samples from Ranch #5 and Snow Ranch were somewhat higher than average, they were within the range of data reported by EPA. Natural K-40 ranged from 1040 to 1900 pCi/l. Tritium in milk was less than 1 pCi/ml. Tritium in urine samples collected October 8, 1972, was less than 2 pCi/ml. None of the results obtained during the period differed significantly from expected levels. (auth)

5591 (TID-26331) INTERPRETATION OF AN AEROMAGNETIC SURVEY OF THE AMCHITKA ISLAND AREA, ALASKA. Geological Survey Professional Paper 707. Bath, G. D.; Carr, W. J.; Gard, L. M. Jr.; Quinlivan, W. D. (Geological Survey, Washington, D. C.). 1972. 77p. GPO $1.75.

An aeromagnetic survey of about 1,800 square miles of Amchitka Island and the adjacent insular shelf provided information on Tertiary volcanic, intrusive, and sedimentary rocks. This includes identification of rocks that cause anomalies and the lateral extents, structures, and approximate depths of those rocks. Near proposed drill sites, anomalies were examined for features that might be related to faulting. The survey was facilitated by data on the magnetic properties of 347 rock specimens collected from surface exposures and 216 from drill cores and by plots of 25 miles of ground magnetic traverse. The data on magnetic properties furnished bases on which anomalies were related to geologic features; ground surveys classified near-surface rocks as either lava or breccia. (CH)

5592 NATURAL DRAUGHT COOLING TOWERS AND THEIR INFLUENCE ON THE ENVIRONMENT. Mikyska, L. (Vyzkumny Ustav Energeticky, Prague). Brennst.-Waerme-Kraft; 25: No. 2, 48-51(1973). (In German).

Rainfall was studied in the environment of a group of natural draught cooling towers, 100 m high. Various methods were used to measure the quality of the rainfall by measuring the pH, the amount of rainfall and the spectrum of the droplets. Observations were carried out at two different time periods, summer and autumn. The results can be used to decide the position of a power plant. (GE)

5593 JAIF FINDING ON RECENT PUBLIC TRENDS AROUND NUCLEAR SITES. At. Jap.; 16: No. 8, 29-43(Aug 1972).

The Japan Atomic Industrial Forum (JAIF) carried out survey of plant sites, hoping that information on the trend in opposition movement in capital and local areas would provide data from which the future of the nuclear utility industry is predictable and measures necessary to solve siting and environmental problems can be established. Residents in all plant site areas surveyed began to have fear of atomic energy around late 1970 or early 1971, and difficulties set in delaying negotiation and planning for new plants. Environmental protection and siting appear to be mixed in the concept of local people in plant site districts. But a closer look revealed that the people became at one and the same time fearful of environmental hazards, and opposed to provide sites for nuclear projects. In some areas where opposition is strong, residents are seriously divided, and business interests have no choice but to draw on the local assemblies or government strongmen for countermeasures to clear confusion. The result was that the people began to distrust local governments, threw it into an inextricable position, and the industry was left alienated and distrusted. JAIF investigators felt that, despite deep involvement of fisheries in all stages of nuclear projects from siting through construction to operation, fishing interests in most site areas were in less contact with the utility industry than had been thought, except temporary cases when they were in negotiation for compensation. (Japan)

5594 PREPARATION OF ENVIRONMENTAL IMPACT STATEMENTS. Gustafson, P. F. (Argonne National Lab., IL). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 33-35(Feb 1973).

The legislative background required in the preparation of environmental statements is reviewed. The actual procedures followed in developing statements for AEC at Argonne are described in some detail, and the future course of such activities is discussed. (auth)

Thermal Effluents

Refer also to abstracts 5527, 5537, and 7616.

5595 (COO-3062-13) BUOYANT SURFACE JET DISCHARGING NORMAL TO AN AMBIENT FLOW OF VARIOUS DEPTHS. Technical Report 81. Carter, H. H.; Schiemer, E. W.; Regier, R. (Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.). Feb 1973. Contract AT(11-1)-3062. 77p. Dep. NTIS $5.45.

Preliminary results of flume studies carried out between June, 1971 and June, 1972 are reported. (DHM)

5596 NORDIC CONFERENCE ON HYDROLOGY, STOCKHOLM, AUGUST 27-29, 1970. Volume 1. Lund, Sweden; Nordic Association for Hydrology (1970). 274p. (In Swedish and English). (STU-69-1243/P60(Vol. 1); CONF-700842-(Vol. 1)).

From Nordic hydrological conference; Stockholm, Sweden (27 Aug 1970).

Of the twenty-eight papers included, only two are within the subject scope of Nuclear Science Abstracts. Separate abstracts have been prepared for these two. (DEB)

For abstracts of individual papers see: 5597 and 5598.

5597 THERMAL EFFECTS OF HEATED EFFLUENTS IN LAKE MAELAREN. Carlsson, B. (Sveriges Meteorologiska och Hydrologiska Inst., Stockholm). pp 219-228 of Nordic Conference on Hydrology. Lund, Sweden; Nordic Association for Hydrology (1970). (In Swedish)

From Nordic hydrological conference; Stockholm, Sweden (27 Aug 1970). See STU-69-1243/P60(Vol.1); CONF-700842-(Vol.1).

SMHI has made investigations of the thermal effects of heated effluents in Lake Mälaren from one power station at Hässelby outside Stockholm, and from two power stations at Västerås. Electrical effects are 160 resp. 200 and 300 MW. In summer in the Västerås bay a distinct horizontal temperature gradient above the thermocline has been measured to a distance of at least 10 km from the effluent. Outside Hässelby–depth 15-20 m–the cooling water has in wintertime stratified at 10-15 m depth, and this has been observed at a distance of more than 5 km from the plant. At the Västerås bay–depth 10-15 m–the cooling water has in winter mostly followed the bottom figuration but also more or less increased the temperature of all the water. The heated water near the bottom has been observed more than 10 km from the heat-power-stations. Calculations show that in winter about 20-40% of the heat dispersed into the atmosphere through the hole in the ice at the effluent. (SW)

5598 COOLING WATER OUTLETS. Larsen, I. (Vattenbyggnadsbyraan, Stockholm). pp 229-232 of Nordic Conference on Hydrology. Lund, Sweden; Nordic Association for Hydrology (1970). (In Swedish).

From Nordic hydrological conference; Stockholm, Sweden (27 Aug 1970). See STU-69-1243/P60(Vol.1); CONF-700842-(Vol.1).

The main factors governing the spreading of cooling water over a recipient are discussed. The wind contributes significantly by increasing the rate of cooling, by displacing the layer of cooling water and by increasing the level of turbulence in the recipient. These phenomena can hardly be studied in a reduced model. Precooling in cooling towers may decrease the heat load on the recipient by 75% at a much smaller cost than that of a closed cooling water system. (SW)

5599 WAYS OF NULLIFYING THERMAL POLLUTION. El Mahgary, Y. (Imatran Voima Oy, Helsinki). Sahko; 46: No. 2, 89-95(1973).

The possible negative effects of waste heat on the environment are treated and the available methods for nullifying these effects are discussed. It is also tried to point out the subjects that need investigation. (auth)

5600 THERMAL POLLUTION PROBLEMS IN JAPAN. At. Jap.; 16: No. 8, 25-28(Aug 1972).

In recent years, the problem of thermal pollution has drawn social attention as a major public hazard in Japan. While industrial establishments that discharge hot waste water, origin of the thermal pollution, are power plants, iron and steel works, chemical plants, and food processing plants, use of cooling water by both thermal and nuclear power plants is actually the major issue. It is expected that power generation and accompanying discharge of the used cooling water in Japan will increase very much in the future, and it is recognized that the thermal pollution affects the environment as seriously as other forms of water pollution. However, the thermal pollution has not been taken up from the standpoint of environmental preservation or ecology. The Water Pollution Prevention Law covers the same conditions as the Fundamental Law on Countermeasures against Public Hazards, making the thermal pollution subject to control in accordance with the waste water control standard set up to cover other forms of water pollution. But the Environmental Agency responsible for setting the standard began investigation into the actual situation and the effect of the thermal pollution in 1971, and is expected to have the standard ready by 1974. (Japan)

Chemical Effluents

Refer also to abstracts 5526, 5527, 5535, 5538, and 5542.

5601 (AERE-R-6231) AMMONIA AND RELATED ATMOSPHERIC POLLUTANTS AT HARWELL. Part I. Techniques for Hourly Sampling and Analysis of Pollutants. Part II. Correlation of Results of Hourly Sampling. Healy, T. V.; McKay, H. A. C.; Pilbeam, A. (Atomic Energy Research Establishment, Harwell (England)). Oct 1972. 57p. Dep. NTIS (U. S. Sales Only). UK 1 £.

Methods for sampling of ammonia and sulfur dioxide gases and ammonium and smoke particulates in the atmosphere over one hour periods have been developed. Some of the inherent difficulties in short term sampling, such as high blanks in the sampling media, are discussed. Analytical techniques have also been improved, and the final procedures for sampling and analysis are described. An automatic hourly sampling device is also described. (auth)

5602 FOSSIL FUEL BURNING AND CARBON DIOXIDE: A PESSIMISTIC VIEW. Pytkowicz, R. M. Comments Earth Sci., Geophys.; 3: No. 1, 15-22(1972).

The impact of the combustion of fossil fuels on the content of CO_2 in the atmosphere and the consequences for Earth ecosystems are postulated. It is pointed out that the rate of fossil fuel consumption has increased by an average of 4.5%/yr during the past century and this has led to a steady buildup in atmospheric and oceanic CO_2. Mechanisms by which CO_2 is removed from the atmosphere and seawater by oceanic sedimentary processes are reviewed. Calculations show that by 1966 man had produced and injected into the atmosphere 95 times as much CO_2 as was removed by oceanic sedimentary processes, which are primarily biogenic. Should levels of CO_2 in the atmosphere continue to increase, it is predicted that catastrophic warming of the surface of the earth will occur, possibly during the next century, and this will lead to a melting of polar ice caps with a decrease in the albedo of the Earth's surface, a slowdown of the deep circulation of the oceans and the cycling of nutrients in the oceans, a rise in sea level with flooding of coastal plains, an enhancement of weathering processes due to higher levels of atmospheric CO_2 and humidity, and changes in both animal and plant ecosystems that would have a detrimental impact on human populations. (CH)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstract 6109.

5603 (AD–751943) NONLINEAR TIME-DEPENDENT PHENOMENA IN JXB DEVICES APPLICABLE TO MHD POWER GENERATORS AND ELECTRIC PROPULSION ENGINES. Final Report. Demetriades, S. T.; Argyropoulos, G. S.; Maxwell, C. D.; Zwick, S. A. (STD Research Corp., Pasadena, Calif.). Sep 1972. Contract F44620-70-C-0001. 94p. (AFOSR-TR–72-2181). NTIS.

A realistic analytical method of modeling the time-dependent behavior of MHD generators and accelerators is described. This method can give accurate quantitative prediction of the performance and efficiency of an MHD generator channel as a function of its size, and can dictate the choice of operating conditions and geometry that will optimize the efficiency and longevity of an MHD power generator of a given size. It can simulate detailed, fluctuating dynamic behavior of segmented-electrode MHD power generators operating in an intermittent or burst mode, or steady-state MHD generators including the start-up phase. The modeling is performed by numerical (digital) techniques. (auth)

General Detectors and Monitors

Refer also to abstracts 5087, 5113, 5120, 5425, 5875, 6545, 7012, 7013, and 7336.

5604 (AERE-PR/NP–18, pp 53-54) MEASUREMENT OF NUCLEAR INTERACTIONS IN PLASTIC SCINTILLATOR. Blair, I. M.; Baker, C. A.; Bonner, B. E.; Edgington, J. A.; Howard, V. J. Mar 1972.

5605 (BNL–50336, pp 32-80) SEMICONDUCTOR DETECTORS. Dearnaley, G. (Atomic Energy Research Establishment, Harwell, Eng.). Feb 1973.

In interaction of energetic charged particles with solids.

It is attempted to show how a thorough study of the behaviour of semiconductor radiation detectors leads one logically into a variety of interrelated investigations at the borderline of nuclear and solid-state physics. Topics include the solid-state ionization chamber, the principles of detector fabrication, the use of semiconductor detectors, the mean energy for electron–hole pair creation, the Fano factor, ion channeling in semiconductors, trapping in detectors, ion implantation of semiconductors, electrical phenomena in amorphous oxide films, and radiation damage in semiconductor detectors. (47 references) (WHK)

5606 (BNL–50336, pp 305-330) SOLID-STATE TRACK DETECTORS: ACHIEVEMENTS AND CURRENT PROBLEMS. Walker, R. M. (California Inst. of Tech., Pasadena). Feb 1973.

In interaction of energetic charged particles with solids.

A review on dielectric track detectors is given. Topics include the basic phenomena, geochronology, energetic particles from the sun and the galaxy, element mapping, dosimetry, controlled production of small holes, and current problems and future perspectives. (73 references) (WHK)

5607 (CEA-CONF-2162) MEASUREMENT OF REACTOR NEUTRON FLUX WITH HIGH-TEMPERATURE FISSION CHAMBERS AND COBALT COLLECTORS. Bacconnet, E.; Dauphin, G.; Duchene, J.; Verdant, R. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1972. 20p. (In French). (CONF-730108-1). Dep. NTIS (U. S. Sales Only).

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973).

Twenty cobalt collectors were tested in reactors. Their functioning was satisfactory. Three of them integrated 5×10^{21} n/cm^2. Their sensitivity is 0.7 and 1.8×10^{-22} A/nv/cm for emitters 1 and 2 mm in diameter. Their response time is instantaneous. The components of the background were studied. The user must consider them separately. The fact that the background of a collector cannot be represented by a unique value was shown. The use of the collectors was examined, and their use for flux mapping or the safety of power reactors was examined. With respect to the fission chambers, the long-duration functioning of miniature fission chambers operating in a pulse regime up to 600°C was studied and the results are given. The behavior of chambers containing a gaseous mixture assuring a fast response time and chambers in which the filling gas causes only a relatively slow response time were also studied. The actual results are reported on 11,740 h of operation of which some 5,000 were at 500°C and 3,340 hours at 600°C. (tr-auth)

5608 (COO–3545-1) CADMIUM TELLURIDE DETECTORS. Second Interim Technical Report, 1 July 1971–30 June 1972. Wald, F.; Bell, R. O.; Serreze, H. B. (TYCO Labs., Inc., Waltham, Mass.). Jul 1972. Contract AT(11-1)-3545. 107p. Dep. NTIS $5.45.

This annual interim report summarizes the crystal growth, material characterization, device fabrication, and evaluation of cadmium telluride for use as a nuclear radiation detector. The most important results have been to refine the travelling heater method of crystal growth (THM) to improve the crystalline perfection and to demonstrate the use of halide dopants (Cl, Br, and I) in the Te solvent zone to produce high resistivity (in most cases 10^6 Ω-cm or greater) CdTe with good characteristics as gamma-ray radiation detectors. Also, a model using two Cd vacancies associated with a dopant ion from Group III or Group VII to form a neutral complex has been developed to explain the high resistivity found in compensated CdTe. (auth)

5609 (TID–26313) IODINE-127 FLUORESCENCE STUDIES AND IODINE-125 EMISSION STUDIES BY MEANS OF A LITHIUM-DRIFTED SILICON DETECTOR SYSTEM. Hwang, Y. (Vanderbilt Univ., Nashville, Tenn.). Aug 1972. 75p. Dep. NTIS $5.75. Thesis.

A 25 mm^2 lithium-drifted silicon detector and a 17.2 curie ^{241}Am excitation source were used in the fluorescent studies. The line spread function (LSF) measurements in air and in water, the modulation transformation function (MTF) calculations of the corresponding LSF's, phantom and patient thyroid scans, thyroid-phantom quantitative studies, and cardiac-phantom output studies are presented. The results of the LSF's and MTF's as well as the thyroid scan images show that fluorescent scans by means of this detection system are possible. The efficiency and the spatial resolution are poor for this detector system but these can be improved with a larger and higher quality detector, and an improved source design. The linear relationship between iodine content and the fluorescent x-ray counts is demonstrated. It is a powerful tool for detecting variations in the thyroid iodine content. The results of cardiac output studies are also encouraging. Animal and patient studies will be possible with a more efficient detector system. The comparison of LSF's, MTF's, and thyroid phantom scan studies of a NaI detector system and this Si(Li) system are also presented. The sensitivity deficiency of the Si(Li) system is the dominant drawback. However, the superior LSF's and MTF's in comparison to a conventional NaI detector are demonstrated. (auth)

5610 SCHETCHIKI ELEMENTARNYKH CHASTITS. (Elementary Particle Counters). Belousov, A. S. Moscow; Izdatel'stvo Nauka (1972). 160p.

The beginning chapter of this small monograph examines the various types of radiation which can interact with matter: charged particles, γ-radiation, and neutrons. Subsequent chapters discuss ionization chambers, scintillation counters, Cherenkov counters, photomultipliers, semiconductor counters, and spark chambers. Applications of these devices include the measurement of particle velocities and the energies of electrons and γ-quanta. (KSW)

5611 OSNOVY METROLOGII NEITRONNOGO IZLUCHENIYA. (Fundamentals of the Metrology of Neutron Radiation). Vasil'ev, R. D. Moscow; Atomizdat (1972). 312p.

The scientific bases for the measurement of neutron radiation in reactors and from isotopic sources are presented. Indirect measurement from ratios of neutron cross sections, or from the cross sections of reactions which generate neutrons, or from cross sections of concomitant reactions are described. Special techniques of direct measurement, international comparison procedures, and standard samples are examined. (315 references) (KSW)

5612 TRANSITION EFFECT IN IONIZATION LOSSES OF HIGH ENERGY PARTICLES. Garibyan, G. M.; Ispiryan, K. A. JETP Lett. (USSR) (Engl. Transl.); 16: No. 11, 413-415(5 Dec 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 11, 585-588(5 Dec 1972).

The use of the relativistic growth of charged-particle ionization losses in the gas of a proportional counter to identify high-energy particles is discussed. The measured relativistic growth of the ionization loss has been found to be smaller than the calculated one; and it is attempted to find a possible mechanism that explains the decrease and discuss methods to reduce the effect. (WHR)

5613 NEUTRON IONIZATION CHAMBERS WITH A PNEUMATIC MONITORING DEVICE. Dmitriev, A. B.; Malyshev, E. K.; Prokhorov, V. V. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 1052-1053(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 75-76(1972).

The construction of neutron chambers with a pneumatic monitoring device is described. The parameters of the chambers are presented. (auth)

5614 FLAT SLOW-NEUTRON SCINTILLATION DETECTOR WITH A BENT LIGHTGUIDE. Kazakevich, G. M.; Ponomarchuk, V. A.; Filippov, E. M.; Shestel, S. T. (Inst. of Geology and Geophysics, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 1049-1051(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 72-74(1972).

A thermal-neutron scintillation detector having an area 200 × 200 mm and a low sensitivity to γ radiation was investigated. The light was extracted through the lateral phase by means of a bent lightguide. It was shown that a comparatively simple amplitude-time discrimination scheme allowed the sensitivity of the detector to γ radiation to be reduced and the signal-to-noise to be increased abruptly. (auth)

5615 RELATIVE ENERGY EFFICIENCY OF A LiF-DETECTOR. Kudelin, K. M. (State Scientific-Research Inst. of Metrology, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 1044-1045(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 68-69(1972).

The curve for the relative energy sensitivity (efficiency) of a LiF crystal is given for γ and x radiation at energies ranging from 15 keV to 1.3 MeV; in accordance with the measured efficiency, the equipment spectrum of the radiation is scaled to the intensity spectrum. (auth)

5616 SURFACE-BARRIER DETECTORS MADE OF p-Si. Vakhtel, V. M.; Degtyarenko, V. N.; Sukhotin, L. N. (Voronezh State Univ., USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 1042-1043(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 66-67(1972).

The influence of temperature during the deposition of the contacts and of the conditions governing surface treatment of the parameters of p-Si surface-barrier detectors is considered. (auth)

5617 SYSTEM FOR RECORDING AND STUDYING NUCLEAR PROCESSES THAT TAKE PLACE WITH VERY SMALL CROSS SECTIONS. Gol'dberg, V. Z.; Kurashov, A. A.; Paramonov, V. V.; Rudakov, V. P.; Timofeev, V. A.; Chesalov, A. A. (Inst. of Atomic Energy, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 1060-1063(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 82-85(1972).

A system for recording charged particles is described which allows considerable reduction of the background caused by particles from secondary reactions and superposition of signals in the measurement channel. The system was tested for measurements of the spectrum of ^{6}He ions from the ^{9}Be(^{3}He,^{6}He)^{6}Be reaction (cross section $\approx$10 μb/sr). For measurement-channel loadings of $\approx 10^4$ pulses/sec a 25-fold reduction of the background was achieved, which amounted to <1 μb/sr when converted into background cross section. (auth)

5618 EFFECTS OF THE COMPOSITION OF SCINTILLATING SOLUTIONS AND EXTINGUISHING FACTORS ON THE EFFICIENCY OF MEASUREMENTS OF ^{14}C AND TRITIUM. Skierski, J.; Marczak, A.; Kowalski, H. Pol. Przegl. Radiol. Med. Nukl.; 36: No. 6, 799-808(1972). (In PL).

The results of investigations on the properties of selected scintillation solutions of different composition are described from the standpoint of efficiency of measurements and the effects of extinguishing agents—water—urine and NCS fluid on the efficiency of measurements for ^{14}C and tritium. The usefulness of different scintillation solutions for measurements of radioactivity of low-energy emitters of beta radiation is discussed. A solution containing toluene, dioxane, cellosolve, naphthalene, and scintillators PPO and POPOP is recommendable. (auth)

5619 THEORETICAL AND EXPERIMENTAL STUDY OF THE GAS AMPLIFICATION IN A LOW PRESSURE CYLINDRICAL PROPORTIONAL COUNTER. Cukier, M.; Dhez, P.; Jaegle, P. (Paris Univ., Orsay, France). Rev. Phys. Appl.; 7: No. 4, 357-365(Dec 1972). (In French).

The optimal efficiency of a cylindrical proportional counter used as a detector for soft x rays was studied. The experimental gas gain until the gas amplification coefficient reaches the value 10^3 was analyzed for a methane pressure lower than one hundred torrs and a counter voltage of about one thousand volts. The counter can work as an integrating flow detector. At low pressures, the usual analytical gas amplification formulas are not available. Hence, using a simple physical assumption, calculations which simulate an electronic avalanche were performed. The three adjustable parameters used in this method can be given a physical interpretation. (FR)

5620 NEUTRON DETECTION BY FISSION TRACK REGISTRATION. Iida, H. (National Inst. of Radiological Sciences, Chiba, Japan); Koshijima, T.; Takahara, H. Australas. Radiol.; 16: No. 4, 427-433(Dec 1972).

A practical method for neutron detection with fission fragment tracks in solids was investigated. Dosemeter glass FD-P8-3 (Toshiba) and cellulose triacetate sheet were used for track registration. A solution of uranylacetate or thorium chloride was dried onto the solid as a fissionable layer. The effect of layer thickness on track density was considered. There was a linear relationship between track density and neutron flux. Saturation thickness of the layer was about 5 mg/cm^2. The combination of a dosemeter glass with uranylacetate had a sensitivity of 1.9×10^{-6} tracks/n for Ra—Be. (AT)

5621 MEASUREMENT ERRORS IN NUCLEAR COUNTERS CALIBRATED BY USING THE RATIO METHOD. Stone, J. F. (Oklahoma Agricultural Experiment Station, Stillwater). Okla., Agr. Exp. Sta., Tech. Bull.; No. T-129, 1-8(1969).

Nuclear counters are often calibrated by comparing a count in the medium under study to a count in a standard system. Errors due to the well known uncertainties of radioactive counting are thereby often masked in the final computation. Desirable features of the reference material are specified and methods of handling and computing counting errors in the calibrated reading are suggested. This can also serve as an aid to improving the use of instruments employing ratio calibration. (auth)

5622 METHOD OF REGROWING CRYSTALS OF CADMIUM SULPHIDE FOR SCINTILLATION COUNTERS. Mikulyak, R. M. (to Bell Telephone Labs.). U. S. Patent 3,725,008. 3 Apr 1973. Filed date 18 May 1970. 4p.

In order to regrow a mass of small crystals of cadmium sulfide, they are placed at one end of a sealed evacuated tube (10^{-5} torr typically). This end of the tube is held at a temperature which is approximately equal to or slightly greater than the sublimation temperature of the cadmium sulfide crystals, while the other end of the tube is held at a still higher temperature. Thereby, the mass of small crystals is regrown at the same tube site under conditions of solid-vapor equilibrium, and in effect coalesced into larger crystals which are useful as scintillation phosphors to detect gamma rays of the order of 100 keV or more. (Official Gazette)

5623 METHOD AND APPARATUS FOR DETERMINING EFFICIENCY IN A LIQUID SCINTILLATION COUNTING SYSTEM. Laney, B. H. (to Sanders Nuclear Corp.). U. S. Patent 3,725,657. 3 Apr 1973. Filed date 11 Jun 1971. 18p.

A method and apparatus for determining the efficiency of coincident pulse detection in a liquid scintillation system utilizing plural photomultiplier means is described. The invention is particularly useful for compensating for color quenching in liquid samples. Various incremental counting efficiency levels are associated with asymptotic functions in a two dimensional matrix in which the abscissa and ordinate correspond to the pulse heights of each of a pair of coincident pulses from different photomultiplier means. An efficiency determining point is located in the matrix based on the sum of the pulse heights of each of the coincident pulses as well as on the amplitude of the smallest pulse of the coincident pulses. The single counting efficiency level associated with a function passing through the efficiency determining point is recorded as the level of efficiency at which the photomultiplier means detect scintillations that generate coincident pulses having pulse heights equal to those recorded. (Official Gazette)

5624 OPERATING CHARACTERISTICS OF THE KNK-53M NEUTRON IONIZATION CHAMBER. Dmitriev, A. B.; Malyshev, E. K.; Chipurenko, N. I.; Shchetinin, O. I. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1597-1598(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 255(1972).

The allowable working currents of an industrial KNK-53M neutron ionization chamber were determined for supply voltages <500 V. It was shown that the maximum working current at a voltage of 500 V is 15 mA. (auth)

5625 ANTICOINCIDENCE INSTALLATION FOR INTERNAL COUNTING COUNTER. Sirbu, M. (Institutul de Fizica Atomica, Bucharest). Stud. Cercet. Fiz.; 24: No. 6, 769-771(1972). (In Rumanian).

A G—M anticoincidence system of the type AC-100-A is described. The installation is used for the determination of geological ages by the Kr—Ar method. (auth)

5626 PORTABLE BATTERY-POWERED RATEMETER AND SCINTILLATION COUNTER FOR THE MEASUREMENT OF HUMAN MYOCARDIAL BLOOD FLOW USING ^{133}Xe. Ikram, H. (Charing Cross Group of Hospitals, London); Rubin, A. P.; Jewkes, R. F.; Bartoli, A. Bio-Med. Eng.; 8: No. 3, 121-122(Mar 1973).

A portable battery powered ratemeter and scintillation detector (isotope localization monitor model 235, marketed by D. A. Pitman Ltd, Weybridge, Surrey), in general clinical use for venous thrombosis detection, was used for the measurement of myocardial blood flow in man by selective injection of ^{133}Xe. A brief description is given of the method used in five patients with ischemic heart disease. The results varied from 35.4 to 74.9 ml/min/100g of tissue and were comparable with previous studies. Coronary vasodilators produced increases in myocardial blood flow as expected. (UK)

5627 RADIOISOTOPE SCANNER FOR RECTILINEAR, ARC, TRANSVERSE SECTION, AND LONGITUDINAL SECTION SCANNING: (ASS: the Aberdeen Section Scanner). Bowley, A. R.; Taylor, C. G.; Causer, D. A.; Barber, D. C.; Keyes, W. I.; Undrill, P. E.; Corfield, J. R.; Mallard, J. R. (Univ. of Aberdeen, Eng.). Brit. J. Radiol.; 46: No. 544, 262-271(Apr 1973).

The construction and operation of the Aberdeen Section Scanner (ASS) is described, with a few clinical examples. The scanner is a dual headed device which can perform conventional rectilinear scans and the more recently developed section or tomographic scans. A punched paper-tape output from both heads is incorporated in the system so that count and position information may be fed into a PDP 81 computer enabling subsequent image processing and display. The same computer and display unit are optionally "on-line" to a Nuclear Enterprises gamma camera. The link to the ASS means that the advantages of computerized image processing are available for scans carried out with the new rectilinear scanner. Various design features are discussed together with the storage and display facilities. The routine operation of the scanner and the initial clinical results are also described. (auth)

5628 RAPID GENERATION OF WHOLE-BODY RADIOAUTOGRAMS WITH MICROCHANNEL PLATE ELECTRON IMAGE AMPLIFIERS. Liss, R. H.; Lindsay, D. B.; Catchpole, C. E. (Arthur D. Little Inc., Cambridge, MA). Nature (London); 242: No. 5399, 523-525(20 Apr 1973).

A new simple technique is described for the efficient and rapid generation of radioautographic images, using a microchannel plate electron image amplifier to detect electrons emitted from the surface of labelled tissue. The microchannel plate (Bendix Research Labs.) forms a small and simple low noise amplifier of electron images, and consists of a parallel array of glass tubes, each of which is coated on the inside with an electrically conducting material. Multiple electrons are emitted on single electron impact. About 1000 V are applied across the channel plate, and the electron gain is about 10^4. Specimens are placed against the input surface of the microchannel plate in a high vacuum chamber. Tritium labelling is used, and as the T decays electrons emerging from the tissue surface are multiplied in the active volume of the microchannel plate, giving rise to a several thousand fold electron emission, that is imaged onto a phosphor screen light from which is photographed. In tests a useful image was obtained in 15 min. The tests were made with rats labelled with tritiated deoxycyline. The radioautographic system is shown diagrammatically. The technique can be applied to whole-body sections, paper chromatograms, or any fixed solid material that can withstand high vacuum and that does not cause contamination of a vacuum system. The microchannel plate and phosphor screen can be used repeatedly, after exposure to the atmosphere. At present, however, the resolution is inferior to that achieved by conventional x-ray film radioautography. (UK)

5629 DEVELOPMENT OF NUCLEAR VISUAL DISPLAY DEVICES AT THE LETI. Allemand, R. (CEN, Grenoble, France). Bull. Inform. Sci. Tech. (Paris); No. 176, 41-51(Dec 1972).

Instrumentation studies in neutron diffraction and nuclear medicine are discussed. Special cameras (multidetectors) were developed for neutron imaging which enable the direct visual display of the patterns produced. Such cameras present a considerable time gain in comparison with conventional goniometers, and thus open up new research possibilities. In nuclear medicine, gas filled x-or γ-ray multidetectors designed by LETI enable radioisotope organ mapping and low-energy tracer ($E < 80$ keV) kinetic studies to be performed. Current investigations concern the development of a high detection efficiency γ-ray camera ($E > 80$ keV) having a large field of view and a high spatial resolution. (FR)

5630 POLARIZATION OF FLUORESCENT LIGHT EMITTED BY PLASTIC NE102A, KI(Tl), CsI(Tl), AND ANTHRACENE. Wohanka, A. E. (Univ., Goettingen, Ger.). Z. Phys.; 258: No. 3, 251-262(1973). (In German).

An investigation of the optical isotropic KI(Tl), and CsI(Tl) scintillators and NE102A plastic scintillators revealed a nonvanishing degree of polarization of the emitted light. Since the arrangement is otherwise symmetrical, this polarization is due to the mechanism of activation by 27.5-MeV deuterons. Measurements of fluorescence light emitted by anthracene crystals at room temperature showed within the apparent uncertainty no dependence of polarization from the direction of activation. However, such a dependence was found at the temperature of liquid air. (GE)

5631 COMPACT VACUUM STOP VALVE FOR A CRYOSTAT WITH A GERMANIUM DETECTOR. Grinberg, A. P. (Physical Technical Inst., Leningrad). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1260-1261(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 241-242(1972).

A compact vacuum stop valve that replaces the cumbersome vacuum valve usually employed is described. (auth)

5632 LIQUID SCINTILLATION MIXTURE. Krumbiegel, P.; Schmidt, H. (to Deutsche Akademie der Wissenschaften zu Berlin). British Patent 1,302,888. 10 Jan 1973. Filed date 12 Mar 1970. 3p.

A liquid scintillation mixture is described the design of which is intended to increase effectiveness of detection of low energy β-particles and substantially reduce the extinction effect with radioactive material dissolved in water, alcohols, or quaternary ammonium bases. The mixture comprises one or more organic scintillators in a solvent selected from toluene, α-methylnapthalene, ditolymethane or the xylenes. This solvent is perdeuterated to at least 97 at. %. A wavelength shifter may also be present, such as 1,4-di-(2-(5-phenyloxazolyl))-benzene. The organic scintillator may be a phenyloxadiazole such as 2-phenyl-5-(4-biphenyl)-oxadiazole. The measurement effectiveness is stated to be increased by a factor of 1.3 to 6 compared with non-deuterated mixtures. (UK)

5633 MEASUREMENT OF THE PARAMETERS OF THE NEUTRON FIELD AND THE γ RADIATION AT THE IRRADIATION POSITION FOR A SYSTEM OF VACUUM PNEUMATIC TRANSPORTERS. Dzhordzh, E. T.; Dzhafar, D. D.; Al'-Abbasi, M. A.; Al'-Shakhiri, G. Yu.; Borisov, G. I.; Dikarev, V. S.; Zhuravlev, O. K. pp 28-32 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5634 OPTIMIZATION METHOD FOR SPECTROMETRIC CONDITIONS IN RADIOISOTOPE DIAGNOSTICS. Kostylev, V. A.; Rzhevskii, V. E.; Fishman, L. Ya.; Narkevich, B. Ya.; Tochilin, V. O.; Matveev, I. M. pp 104-111 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5635 MEASUREMENT OF THE AVERAGE ENERGY OF A γ-RADIATION SPECTRUM. Bukhalo, O. P.; Ivanov, V. I.; Kulakov, G. V. pp 129-130 of Prikladnaya yadernaya Spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5636 SOME FEATURES OF THE RECORDING AND MEASUREMENT OF FISSION PRODUCT ENERGY BY SEMICONDUCTOR DETECTORS. Solov'ev, S. M.; Eismont, V. P. pp 201-205 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5637 TRANSISTORIZED PREAMPLIFIER WITH REGULATED SIGNAL CUTOFF FOR OPERATION WITH SEMICONDUCTOR DETECTORS OF NUCLEAR PARTICLES. Zaki, V.; Zubritskii, L. A.; Lobkovskii, A. P. pp 206-209 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5638 METHODS FOR CALIBRATION OF NEUTRON SCINTILLATION DETECTORS. Trykov, L. A.; Tyufyakov, N. D. pp 254-261 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5639 SMALL-CURRENT INTEGRATOR. Glass, F. M. (to United States Atomic Energy Commission). U. S. Patent 3,727,077. 10 Apr 1973. Filed date 25 Aug 1971. 8p.

An integrating circuit for quantizing currents as small as 10^{-12} ampere for radiation detectors such as ion chambers is described. The over-all integrating principle is fairly conventional. However, a much simplified and improved charge removal technique and an electrometer-type operational amplifier having common-mode feedback for stabilization in the event of radiation damage substantially improve operation. (Official Gazette)

5640 INSTRUMENTATION IN APPLIED NUCLEAR CHEMISTRY. Krugers, J. (ed.). New York; Plenum Publishing Corporation (1973). 396p. $25.00.

Topics by chapter title include the basic theory of nuclear processes, systems and their use (detectors and instrumentation), applications, detectors, NIM standard, preamplifiers, amplifiers, single-channel amplifiers, multichannel analyzers, statistics, timing circuits, and use of computers. (WHK)

5641 THE REVEALING OF INFORMATION CONCEALED IN OVEREXPOSED X-RAY TOPOGRAPHS. Mardix, S. (Univ. of Rhode Island, Kingston). Appl. Phys. Lett.; 22: No. 5, 214-215 (1 Mar 1973).

5642 DEMOUNTABLE SAMPLE CELL HOLDER AND CELL FOR LIQUID SCINTILLATION COUNTERS. Neary, M. P. (to Beckman Instruments, Inc.). U. S. Patent 3,724,956. 3 Apr 1973. Filed date 27 Nov 1970. 4p.

A demountable sample cell holder and cell is provided to adapt liquid scintillation counters for chemiluminescence measurements. The cell holder is cylindrical and mounts in one of the photomultiplier apertures. A sample cell is mounted within the cylinder by pliable spacers and is connected to inlet and outlet fillings on the cell holder by coiled black tubing. The cell is aluminized to enhance photon transfer efficiency and painted black. The holder is formed into two sections which may be unscrewed so that differing size cells may be utilized. (Official Gazette)

5643 LONG-TERM TEST OF SELF-POWERED NEUTRON DETECTORS IN HBWR. Bradas, M. (Institutt for Atomenergi, Halden, Norway); Strindehag, O.; Soderlund, B. Nucl. Eng. Int.; 18: No. 204, 421-425(May 1973).

Experiments are described on long-term testing of V and Co detectors in the HBWR. Basic data on the detectors and their loading history are tabulated. Most of the work is performed in rig PEI 306, to thermal neutron fluxes of 6×10^3 n/cm^{2}s. Fluences for each detector are given together with insulation resistances and failure rates. Fluences are not corrected for burnup, the estimated value of which is higher for Co detectors than for V, but this disadvantage is considered to be far outweighed by prompt response times of Co detectors. ^{60}Co build-up is similar to the theoretically predicted value. It is concluded that the detectors have excellent reliability comparable with that of many electronic components. (UK)

5644 SIMPLE APPARATUS FOR BORON AND LITHIUM CONCENTRATION MEASUREMENTS BY NEUTRON ABSORPTION. Frazzoli, F. V.; Mancini, C. (Univ., Rome). Kerntechnik; 15: No. 3, 136(1973).

A simple apparatus is described which utilizes an isotopic neutron source and a BF$_3$ counter for measurements of concentration of elements with high neutron capture cross section. The sensitivity for Li and B is in the range of 10 to 50 ppM with measuring times of 100 s. (GE)

5645 NUCLEAR RADIATION DETECTOR FOR THE PICOCURIE RANGE. Langeberg, K. Funkschau; 45: No. 3, 94-97 (1973). (In German).

The circuitry, design, and operation of the device are described which consists of a self-quenching window counter tube (valve type 18504) for the dosimetry and detection of α-, β-, γ-, and neutron radiation. (GE)

5646 ALPHA TRACKS IN CELLULOSE NITRATE AS DETECTOR ELEMENTS FOR SPHERICAL MODERATOR TYPE NEUTRON MONITORS. Kumamoto, Y. (National Inst. of Radiological Sciences, Chiba, Japan). Health Phys.; 24: No. 5, 558-559(May 1973).

The utilization of alpha-particle track formation in cellulose nitrate film as detector elements in spherical moderators for measuring the dose equivalent from neutrons is described. Because the cellulose nitrate film is insensitive to gamma-rays, the method can be used in high-level gamma ray fields, such as those found around linacs and betatron facilities. The moderator consisted of a spherical flask (5000 cm^3) filled with water and the detector consisted of ^{6}LiF powder as a source of alpha particles and a cellulose nitrate film. The usefulness of the detector assembly to detect neutron spectrum was demonstrated by measuring the relative response of spheres of 300, 5000, 10000 and 50000 cm^3. To utilize the present method for neutron monitoring, all the procedures from irradiation with a calibrated source to the counting of tracks in the film should be standardized at each facility, because the sensitivity of the method depends on the film characteristics, the radiator thickness and the etching technique. (UK)

5647 TESTING APPARATUS FOR CHECKING AND CALIBRATING THE READING OF NUCLEAR RADIATION MEASURING APPARATUSES. Muscheid, W.; Zuber, W. (to Total Foerstner Co.). German Patent 1,941,318. 27 May 1971. Filed date 14 Aug 1969. (In German).

A beta source for the calibration of radiation detectors is described. It is characterized by having a single block of lead as a shield and an ionization chamber with a beta window. (TSS)

5648 DETECTING RADIATIONS ON CHROMATOGRAMS. Aubin, G.; Abrioux, A.; Leroy, J. (to L'Oreal). French Patent 2,123,737. 15 Sep 1972. Filed date 29 Jan 1971. 13p. (In French).

An apparatus for detecting and measuring radiations at different points of a chromatogram is presented. It consists of a table-support and at least one radiation counter positioned perpendicular to the table. The radiation counter is translated in relation to the fixed table-support. The chromatogram is fixed to the table-support by means of a thin device (windowed plate) made of magnetic material and capable of being attached to the flat surface of the table-support over its entire surface. The table-support is made of ferromagnetic material and forms a permanent magnetic pole. The edges of the chromatogram are inserted between the thin device and the table-support. The apparatus is intended for paper chromatography and thin film chromatography. (FR)

5649 IMPROVEMENTS TO PHOTOMULTIPLIER RADIATION DETECTION SYSTEMS. Drouot, L. French Patent 2,117,748. 28 Jul 1972. Filed date 15 Dec 1970. 5p. (In French).

A system is presented for detecting the radioactivity of a sample placed in a liquid scintillator between the photocathodes of two photomultiplier tubes positioned to face one another. Special means are incorporated between the photocathodes of the two photomultiplier tubes in order to polarize the optical radiation emitted by the photocathodes and obtain a maximum extinction, thus reducing the background noise of the system (crosstalk effect). The polarization device may be in the form of two filters having axes of polarization perpendicular to the geometry of the tubes and adjustable by rotation about these axes. (FR)

5650 INFLUENCE OF BEAM PATH LENGTH IN STANDARD FREE AIR CHAMBERS ON THE PHOTON SCATTER CORRECTION IN LOW ENERGY X-RADIATION MEASUREMENTS. Somerwil, A. (Rijks Instituut voor de Volksgezondheid, Bilthoven, Netherlands). Metrologia; 8: No. 2, 42-46(1972).

The differences can partially be ascribed to the neglecting of the influence of the attenuation path length within the chambers on the scatter correction factor. During intercomparison of standard free air chambers at the Bureau International des Poids et Mesures small but systematic differences were found between two types of chambers, having substantially different internal beam path lengths. An experiment was performed to investigate which influence these differences could have upon the correction factor to be applied for the radiation scattered inside these chambers. (GE)

5651 AUTOMATICALLY ADJUSTABLE RADIOACTIVE RADIATION DETECTOR CIRCUIT. McGunigle, R. D. (to RdF West). U.S. Patent 3,715,593. 6 Feb 1973. Filed date 19 Mar 1970. 10p.

A circuit for measuring short term variations in the average repetition rate of random input pulses, such as from a Geiger counter that monitors the sudden drop in radiation from a test plug containing radioactive wires as the ablative heat shield material is burned away during space vehicle reentry, has a variable one-shot multivibrator that is triggered by each input pulse to generate discrete pulses of selected amplitude and duration. The multivibrator pulses are integrated in a time averaging circuit having a relatively short time constant, compared to duration of the short term variation to be measured, to provide an output signal voltage indicative of the existing input pulse repetition rate. This output signal is delivered through a high gain feedback path having a buffer amplifier and a feedback storage circuit with a relatively long time delay to control a variable impedance element, such as a field effect transistor, in the multivibrator timing circuit to vary the pulse length to compensate for gradual changes in the input pulse rate, such as may result from the slow decline in Geiger counter output rate due to radioactive decay of the material used in the aforementioned test plug wires. (Official Gazette)

5652 OBSERVATIONS ON RATEMETER CONTROLLED COLOUR DOT SCAN DISPLAYS. Keyes, W. I.; Mallard, J. R. (Univ. of Aberdeen, Scotland). Brit. J. Radiol.; 46: No. 545, 369-374(May 1973).

A color scan is described as a recording of the ratemeter reading, each color representing a small range of counting rate. The influence of the statistical significance of these color ranges on the visual extraction of information from the scan is investigated. When each color range extends over two to three standard deviations of a single reading of counting rate within the range, display is considered optimum in the sense that small variations in counting rate are most easily perceived. The standard deviation of an estimate of counting rate obtained by averaging readings over a small area of scan is approximated using a standard formula. This leads to a more accurate knowledge of the changes in counting rate which can be demonstrated and to a criterion for selection of the ratemeter time constant. (auth)

5653 TRIAL MANUFACTURE OF A WELL LOGGING APPARATUS UTILIZING PULSED NEUTRONS. Ito, T. (Japan Petroleum Exploration Corp., Tokyo). Sekiyu Gijutsu Kyokaishi; 36: No. 7, 416-424(Dec 1971). (In Japanese).

Pulsed neutron logging is based on three well-known principles, namely spectral analysis of γ-ray energy induced by nuclear reactions, time analysis of thermal neutrons in formation, and spectral analysis of γ-ray energy emitted from radioactivated nuclides. In this apparatus, the spectral analysis of γ-rays induced by nuclear reactions and the time analysis of neutron capture γ-rays are measured simultaneously with a count controlling gate synchronized with the neutron burst. The relation between the count rate for γ-rays of carbon, oxygen, and chlorine and hydrocarbon content in sandstone was determined with sandstone blocks of different porosity. The hydrocarbon content can be determined from the ratio of carbon γ-ray/oxygen γ-ray value or by time attenuation of neutron capture γ-rays. The pulsed neutron logging apparatus consists of an intra-well apparatus comprising a neutron generating unit and a scintillation γ-ray detector and a ground panel comprising a neutron generating unit controller and a γ-ray measuring unit. Field testing of the logging apparatus was started in April 1971, and results are not sufficient to be reported at the present. In Fukubezawa SK-24 well of JAPEX, the measurement of time attenuation of neutron capture γ-rays showed the possibility of hydrocarbon existence. The resolution of the carbon γ-ray/oxygen γ-ray curve was much superior to that of the carbon γ-ray curve. When salt content in ground water is low, use of a cadmium cap on the scintillator is recommended. This method is effective for both bare wells and wells with steel casing. (JA)

5654 DIRECT INCORPORATION METHOD FOR LIQUID SCINTILLATION COUNTING OF PLASMA SAMPLES BY INTERNAL-EXTERNAL STANDARDIZATION. Bader, C.; Assailly, J.; Chanard, J.; Funck-Brentano, J. L. (Hopital Necker, Paris). Int. J. Appl. Radiat. Isotop.; 24: No. 1, 29-36 (Jan 1973). (In French).

A direct incorporation method for liquid scintillation counting of plasma samples is described. After dilution in saline, the plasma samples are mixed with a new scintillator emulsifying mixture ("Scintigel"). Counting efficiency is obtained by a pseudo-internal method. Results show great significance of plasma quenching particularly in the field of clinical studies. Quench correction curves for tritium, sulfur-35 and calcium-45 are plotted using counting efficiency versus external standard channel ratio. The sample activity in dpm is given with a 5% precision. (auth)

5655 19TH NUCLEAR SCIENCE SYMPOSIUM AND 4TH NUCLEAR POWER SYSTEMS SYMPOSIUM. Conference held at Miami, Florida, December 6-8, 1972. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 1 815(Feb 1973). (CONF-721202-).

From nuclear science symposium; Miami Beach, Florida, USA (6 Dec 1972).

Separate abstracts were prepared for 115 of the 123 papers presented. Seven of the papers were not within the scope of NSA. The remaining paper was previously included in NSA. (WDK)

For abstracts of individual papers see: 5208, 5425, 5553, 5594, 5656–5697, 5762–5770, 5793–5799, 5812, 5821, 5822, 5835–5845, 6492, 6493, 6500, 6541–6544, 6630, 7131, 7166–7171, 7270, 7280, 7302, 7303, 7317, 7347–7349, 7369, 7500, 7501, 7514–7522, and 7610–7613.

5656 RISETIME DISCRIMINATOR FOR LOW LEVEL TRITIUM COUNTING. Bradley, A. E.; Willes, E. H. (Univ. of California, Livermore). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 80-89(Feb 1973).

The design of a risetime discriminator circuit (RTD), with associated anticoincidence/coincidence (AC/C) logic and its application to the counting of low-activity tritium samples in gas proportional counter systems is described. The circuitry, packaged in a double-width NIM, extracts signal risetime information which is used in conjunction with the output of an annular guard counter to electronically reject background counts due to high energy charged particles (μ-mesons), and gamma-ray photons. (auth)

5657 SIDE DETECTION EFFICIENCY OF THE CHANNEL MULTIPLIER. Andresen, R. D.; Page, D. E. (European Space Research and Tech. Centre, Noordwijk, Netherlands). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 99-101(Feb 1973).

The ability of a channel multiplier to record radiation incident through its side walls has been studied, using mono-energetic MeV-electrons and protons and cosmic ray muons. The results indicate that about 25% of the total length of the detector is sensitive to this radiation with a detection efficiency depending on particle type and energy. (auth)

5658 HIGH RESOLUTION POSITION SENSITIVE DETECTOR FOR ULTRAVIOLET AND X-RAY PHOTONS. Riegler, G. R.; More, K. A. (Bendix Aerospace Systems Div., Ann Arbor, MI). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 20, 102-106(Feb 1973).

A new type of position sensitive detection system based on a Chevron microchannel plate photon sensor with photodiodes for ultraviolet and x-ray photons and for particles is described. A compact laboratory model with one-dimensional readout was constructed and tested. The full width at half maximum response to single x-rays was typically 0.13 mm, but the position determination accuracy was comparable to the channel center-to-center spacing of 0.053 mm. The detection system can be readily adapted to two-dimensional readout. Potential applications of this device for single-photon and flux counting in ultraviolet and x-ray astronomy are discussed. (auth)

5659 HIGH PERFORMANCE 4500 VOLT ELECTRON MULTIPLIER BIAS SUPPLY FOR SATELLITE USE. Peletier, D. P. (Johns Hopkins Univ., Silver Spring, MD). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 107-112(Feb 1973).

A tuned-secondary sinewave oscillator combined with a Cockcroft-Walton voltage multiplier has been developed which produces 40 μA at 4500 volts from 12 VDC with 80% efficiency. Optimum efficiency is obtained by considering the Cockcroft-Walton multiplier as part of the oscillator design. Equations are developed for calculating the multiplier output voltage and ripple as a function of the oscillator output frequency and amplitude, the capacitance of the multiplier, the number of multiplier stages, and the load current. The Atmosphere Explorer Photoelectron Spectrometer electron multiplier bias supply is also described to illustrate practical design tradeoffs and techniques employed when the supply is used in a satellite-borne particle detection experiment. (auth)

5660 POSITION-SENSITIVE X-RAY DETECTOR FOR THE HEAO-A SATELLITE. Held, D.; Weisskopf, M. C. (Columbia Univ., New York). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 140-144(Feb 1973).

A position-sensitive, low-energy proportional counter system is described which will be used on the High-Energy Astronomical Observatory, Mission A, space-craft. The associated system incorporates the capability to employ pulse-shape discrimination for background rejection and interpolation circuitry to locate the centroid of an x-ray event with an accuracy of approximately one eighth the cathode-wire spacing. (auth)

5661 MULTIWIRE PROPORTIONAL COUNTER WITH INTEGRAL READOUT DELAY LINE. Emming, J. G.; Gilland, J. R. (Ball Brothers Research Corp., Boulder, CO). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 145-154(Feb 1973).

A new concept for delay line readout of multiwire proportional counters for detecting the position of ionizing particles is described. It significantly reduces the complexity and cost of a multiwire system compared to alternative methods, making it attractive for space flight applications. This integral delay chamber can provide spatial resolution approaching 0.1 mm using ^{55}Fe, provided careful consideration is given to geometrical parameters that determine delay line bandwidth and phase distortion. For a chamber of 35 by 35 cm^2 a delay of 20 ns/cm and attenuation of 0.05 dB/cm has been obtained. The delay line characteristics and electronic resolution, using a peak detection method, are given as a function of chamber geometry. (auth)

5662 CHARGED-PARTICLE SCINTILLATION SPECTROMETER WITH LARGE GEOMETRIC FACTOR. Katz, N.; Kolasinski, W. A.; Solow, S. (Aerospace Corp., Los Angeles). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 155-159(Feb 1973).

A charged particle scintillation spectrometer with a geometric factor of 350 cm^2 sr has been built and flown in polar orbit aboard the Air Force STP 72-1 (1972-076B) Satellite. The primary purpose of the sensor is to measure low-intensity solar proton fluxes over the polar caps, in the energy range of 1 to 15 MeV. Incorporated in the circuitry is a pulse-shape discrimination scheme enabling the instrument to differentiate between protons and electrons. A second pulse shape discriminator prevents analysis of signals produced by particles which penetrate the primary (CsI (Tl)) scintillator and produce light in a backing layer of fast scintillating plastic. (auth)

5663 HIGH SPATIAL RESOLUTION MWPC SYSTEMS USING ELECTROMAGNETIC DELAY LINE READOUTS. Swanson, F. R.; Kuehne, F. J.; Favale, A. J. (Grumman Aerospace Corp., Bethpage, NY). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 160-165(Feb 1973).

Results of an investigation to develop multiwire proportional chamber systems utilizing electromagnetic delay lines for high resolution cosmic ray experiments are described. The delay line used is a plexiglas core type, with a delay constant of 7 nsec/mm. The interpolation properties of this readout scheme resulted in a measured spatial resolution of 75 microns (FWHM), using iron-55 x-rays and a wire spacing of 1 mm. Tracking accuracy over a 6 mm region near the center of the chamber was better than ±7 microns when fitted to a linear spatial dependence combined with a sinusoid of wire-spacing periodicity. (auth)

5664 HYBRID INTEGRATED CIRCUIT FOR MULTIWIRE PROPORTIONAL CHAMBERS. Larsen, R. S. (Stanford Univ., CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 172-181(Feb 1973).

Specifications and block diagrams are given for hybrid integrated circuits for multiwire proportional counters. Tests and results, problems, and cost are discussed. (WHK)

5665 FIELD EFFECT TRANSISTORS FOR CHARGE AMPLIFIERS. Radeka, V. (Brookhaven National Lab., Upton, NY). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 182-189(Feb 1973).

The significance of various noise sources in field-effect transistors for radiation detectors is discussed. The intrinsic thermal noise of the conducting channel can be reduced by reducing the channel length. A lower limit to the channel length is set by the carrier velocity saturation effects, which are the hot carrier channel noise and the gate leakage current due to impact ionization. Devices with a ratio of the transconductance to the input capacitance of 3×10^9 sec^{-1} have been made, and a further improvement appears to be possible. (auth)

5666 NOISE SUPPRESSED LEADING EDGE TRIGGER TECHNIQUE AND ITS APPLICATION TO NaI(Tl) PULSE TIMING. Cho, Z. H.; Beshai, S.; Becker, J. (Univ. of Stockholm). IEEE (Inst. Elec. Electron, Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 199-203 (Feb 1973).

Optimum timing using a simple noise suppressed leading edge trigger technique is described. A short review with formulation of time walks and jitters of various leading edge trigger techniques is given in connection with the noise suppression leading edge trigger (NSLET) technique. As a demonstration of the advantage of the NSLET technique, time resolution of a NaI(Tl) detector has been measured and the improved results are compared with the results obtained with conventional techniques. (auth)

5667 8-CHANNEL SAMPLE-AND-HOLD WITH MULTIPLEXED ANALOG OUTPUT. Chang, A. K.; Larsen, R. S. (Stanford Univ., CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 216-220(Feb 1973).

An economical 8-channel sample-and-hold unit, serially addressable with multiplexed output for measuring pulse charges in large counter experiments is described. The unit accepts clipped inputs of 5 nsec (nominal) FWHM; the positive overshoot of the clipped pulse is rejected. The outputs are held to ±1 mV for ≥1 msec, and are linear to ±1% from 30 mV to 1 V. The output sensitivity is 10 mV per picocoulomb of input charge. (auth)

5668 TECHNIQUE FOR MEASURING EXTREMELY LOW IONIZATION CHAMBER CURRENTS USING MOS FET CIRCUITRY. Rosenblum, L. H. (Picker Corp., North Haven, CT); Bartky, W. S.; Shaifer, T. R. Jr. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 221-224(Feb 1973).

A circuit has been developed for an isotope calibrator which will accurately measure ionization chamber currents in the order of 10^{-14} to 10^{-7} amps. The circuit incorporates a self-zeroing feedback network which virtually eliminates drift, as well as high impedance MOS FET switches and a MOS insulated gate FET source follower in the input circuit to minimize errors due to leakage currents. (auth)

5669 FAST DIGITAL ARITHMETIC DEVICES FOR DECISION MAKING ANGLE SCATTERING EXPERIMENTS. Aliev, F. K.; Guzik, Z.; Tsyganov, E. N.; Turala, M. (Joint Inst. for Nuclear Research, Dubna, USSR). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 225-227(Feb 1973).

A short analysis of a hodoscope system and digital arithmetic devices for selecting a defined scattering angle is made. Some construction and experimental results are presented. (auth)

5670 MINIATURE CHARGE SENSITIVE PREAMP-AMPLIFIER FOR USE WITH SILICON SURFACE BARRIER DETECTORS. Krycuk, G.; Walling, J. D. (Rensselaer Polytechnic Inst., Troy, NY). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 228-231(Feb 1973).

A compact, high speed, low cost, charge sensitive preamp-amplifier has been constructed for use in a mass spectrometer data readout array. The device, which is capable of handling count rates up to 1 MHz, can be mounted on a 2 × 8 cm circuit board. The circuit was designed as a high rate counter-amplifier, but it has also been determined to be sufficiently linear so that with suitable shaping of the output signal, pulse height analysis is feasible. (auth)

5671 COMPUTER STUDY OF TIME RESOLUTIONS AND CHARGE COLLECTION TIMES OF Ge GAMMA-RAY DETECTORS WITH CURRENTLY EMPLOYED PICK-OFF TECHNIQUES. Bohm, C.; Cho, Z. H. (Univ. of Stockholm). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 246-255(Feb 1973).

An attempt to quantitatively calculate the time resolutions from different combinations of Ge gamma-ray detectors, filters, and time pick-off techniques, is described. The study is based on charge collection time calculations previously studied, optimizations of filters, and the choice of parameters in the different time pick-off techniques. Results of the time resolution simulations with a 3 cc planar detector and a 5.6 cc coaxial detector of the Ge(Li) type, are presented and are in good agreement with previously obtained experimental and theoretical results. A brief discussion of the most common trigger modes (and related time jitters and time walks), particularly in reference to the Ge gamma-ray detectors, is also given. (auth)

5672 COMPUTER-BASED SCANNING SYSTEM FOR NUCLEAR MEDICINE. Bell, P. R.; McClain, W. J.; Ross, D. A. (Oak Ridge National Lab., TN). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 256-258(Feb 1973).

A computer-based gamma-ray imaging system has been developed for use with rectilinear scanners. It has been designed as a stand-alone system for the small nuclear medicine clinic. Completely processed images are produced in a time short compared with scanning times. The process for correction of gamma-ray scattering in the patient and penetration of gamma rays through the collimator septa produces marked improvement in the images. (auth)

5673 IMAGE ENHANCEMENT AND ANALYSIS IN NUCLEAR MEDICINE. Harbort, R. A. Jr.; Sprawls, P. Jr.; Stahl, R. S. (Emory Univ., Atlanta). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 259-265(Feb 1973).

Some of the aspects of image processing in the field of nuclear medicine are surveyed. Topics which deal specifically with enhancement of the quality of images as opposed to the interpretation of images are discussed. The purpose of image enhancement is to make the useful or interesting information in an image more accessible to the interpreter of that image. To accomplish this one needs to know what part(s) of the image are useful and how the interpreter interprets them. These parts may then be analyzed and enhanced to provide better information to the interpreter. The analysis and enhancement are discussed. (auth)

5674 RESULTS OF SCATTERING IN RADIOISOTOPE IMAGING. Dresser, M. M.; Knoll, G. F. (Univ. of Michigan, Ann Arbor). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 266-272(Feb 1973).

It has long been recognized that in-patient scattering can lead to significant image degradation in nearly all radioisotope imaging. Using biased Monte Carlo codes and experimental determinations, a study of three aspects of this problem were undertaken: scattering and attenuation within the patient; selective rejection of scattered radiation by angular selection of the collimation system; and selective rejection of scattered radiation by energy selection. The model assumed consists of point gamma ray sources of energy between 140 and 511 keV, located at depths between zero and 10 cm below the surface of a semi-infinite water medium. Ellett has shown that at the energies of interest here, water is a good representation of a tissue medium. A wide variety of general data on the energy and spatial distributions of the escaping scattered radiation have been catalogued. (auth)

5675 ULTIMATE CAPABILITIES OF DETECTORS WITH HIGH ENERGY RESOLUTION IN RADIOISOTOPE SCANNING. Llacer, J. (Brookhaven National Lab., Upton, NY). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 273-281(Feb 1973).

It is now recognized that the use of germanium radiation detectors in radioisotope linear scanning results in improved image contrast by virtue of the almost complete elimination of scattered radiation in the image formation process. Ge(Li) detectors of only moderate resolution (4 to 5 keV) are sufficient to extract practically all the information available from present fine collimators (line source MTF approaching zero at $\nu \simeq 1.6\ \mathrm{cm}^{-1}$). The question presents itself, however, of whether a high resolution Ge detector system (1 to 2 keV) could be used with collimators perhaps 10 times sharper than the present ones, without image degradation due to scattering in absorbing tissue. The purpose of this study was to answer that question by presenting a study of the relationship between detector energy resolution and image quality of collimator-detector combinations in the presence of substantial scattered radiation and a variable counting rate. The recognized capability of high resolution detectors in multiple isotope scanning is discussed. A general mathematical analysis in terms of line source MTF's, showing how a collimator-detector combination results in a particular MTF, is first carried out. Two actual collimators are then studied in detail, obtaining a parameterization of their most important characteristics with the help of a relatively simple model. Collimators of one order of magnitude better spatial resolution than those presently available are then simulated in a computer and their performance is evaluated in conjunction with high resolution detectors in the presence of substantial scattering. Some pictures of square wave radiation distributions are then generated by computer to translate into visual terms the MTF's resulting from the calculations. The effect of counting statistics is finally taken into consideration by looking at the direct influence of a Poisson counting process on the square wave image formation. (WHK)

5676 PRELIMINARY STUDY OF A GERMANIUM THREE-DIMENSIONAL CAMERA FOR POSITRON EMITTING RADIOISOTOPES. Llacer, J.; Cho, Z. H. (Univ. of California, Los Angeles). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 282-293(Feb 1973).

A preliminary feasibility study of a camera for imaging of positron emitting radioisotopes based on two arrays of Ge detectors operated in coincidence has been carried out. Efficiency, effects of energy resolution, and timing characteristics have been studied. It has been found that Ge can compete favorably with NaI in efficiency if Compton signals can be admitted for imaging. Analysis of the effect of scattered radiation indicates the advisability of having some moderate energy resolution in the system. A method is devised which allows the use of the Compton signals of the Ge detectors in a summing mode and, therefore, maintain very good energy resolution. A study of the timing properties of small Ge detectors indicates that count rates as high as one order of magnitude more than those possible with NaI detector arrays should be possible. Also, for the first time, it appears realistically possible that tomography by time-of-flight techniques can be carried out with a camera. It is concluded that a small prototype camera section should be built and investigated further. (auth)

5677 SEMICONDUCTOR RADIATION PROBES FOR NUCLEAR MEDICINE AND RADIOBIOLOGY: THE STATE OF THE ART. Martini, M. (Simtec Industries Ltd., Montreal). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No 1, 294-309(Feb 1973).

An attempt to assess the state of the art of semiconductor probe detectors as a tool for nuclear medicine and radiobiology is presented. The following points are discussed: 1) operation of semiconductor probes in the pulse mode (for tracer work) and in the photovoltaic mode (for dosimetry); 2) encapsulation of the detector element; 3) optimization of the electronics; 4) energy resolution of the probes; 5) spatial resolution of the probes; 6) sensitivity to different kinds of radiation; 7) clinical and experimental applications as given by the literature; and 8) reasons why these devices have not been widely accepted as clinical tools. (45 references) (auth)

5678 GaAs BIOMEDICAL PROBES AND THEIR APPLICATIONS IN NUCLEAR MEDICINE. Kobayashi, T. (Tokyo Shibaura Electric Co., Ltd., Kawasaki, Japan); Sugita, T.; Takayanagi, S. I.; Iic, M.; Sasaki, Y. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 310-317(Feb 1973).

A set of GaAs biomedical probes for in vivo measurement of β- and γ-ray emitting radioactive elements has been fabricated from liquid-phase epitaxial and boat grown GaAs materials. The probes use a GaAs surface barrier diode as a radiation sensing element and utilize three diode structure shapes, such as side window, frontal window, and single ended coaxial structures. The noise performance of the GaAs biomedical probe was less than 18 keV at room temperature. Some of the GaAs probes developed had good counting efficiency for β- and γ-ray emitting radioisotopes and also had good energy resolution for low energy γ-ray and x-ray. The preliminary results of GaAs biomedical probes developed to diagnose malignant tumor and measure regional blood flow were good. The feasibility of GaAs detector as a fluorescent x-ray detector operating at room temperature in nuclear medicine is also discussed. (auth)

5679 DEVELOPMENT AND APPLICATION OF COAXIAL CdTe MEDICAL PROBES FOR USE IN THE CLINICAL ENVIRONMENT. Walford, G. V. (Simtec Industries Ltd., Montreal); Parker, R. P. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 318-328(Feb 1973).

Medical probes utilising CdTe detectors have been developed and their potential for uptake (or tracer) measurements and dosimetry has been evaluated. It is found that they are suitable for uptake measurements involving both beta and gamma emitting radiopharmaceuticals. Under carefully defined operating conditions CdTe probes can give an approximately tissue equivalent response, and so the same probe can be used for dosimetry and uptake measurements. Further work is necessary to fully establish the potential and characteristics of these devices. (auth)

5680 SEMICONDUCTOR DETECTORS AND THE DIAGNOSIS OF PROSTATIC CARCINOMA. Ewins, J. H. (Univ. of California, Los Angeles); Marcus, C. S.; Cosgrove, M. D.; Katzenstein, H. S.; Friedland, S. S. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 329-332(Feb 1973).

Prostatic carcinoma is second only to lung cancer as the most common cause of death from cancer in the United States for males over 50 years of age. In an attempt to facilitate early detection of prostatic cancer, a Si(Li) probe has been constructed and a radiopharmaceutical selected to assist the urologist during rectal examination of the prostate. Probe characteristics and data obtained from patients with and without prostatic carcinoma are presented. (auth)

5681 HIGH RESOLUTION, HIGH EFFICIENCY PROPORTIONAL COUNTER X-RAY CAMERA. St. Onge, R. N. (Univ. of New Hampshire, Durham). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 333(Feb 1973).

A high-resolution, high-efficiency, gas-filled, position-sensitive x-ray camera for diagnostic nuclear medicine is described. The simple integral parallel hole collimator allows a spatial resolution of less than 1 mm and holds down the front foil allowing the counter to be pressurized to greater than 10 atmospheres for high efficiency. (auth)

5682 TRANSMISSION SCANNING USING A CONTINUOUS X-RAY SOURCE. Kraner, H. W.; Alberi, J. L.; Atkins, H. L. (Brookhaven National Lab., Upton, NY). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 389-401(Feb 1973).

A system of rectilinear scanning has been developed which senses the presence of particular elements by measuring the differential attenuation of x-ray photons about a specific absorption edge. A continuous x-ray spectrum generated from a side-window 50 kVcp tube is used and the transmitted beam is detected by an energy selective Ge(HP) semiconductor detector. Measurements on phantoms with absorbers up to 10 cm thick indicate sensitivity to middle Z elements, such as iodine, down to the range of 1 mg/cm^2 in reasonable scanning times. Little effect was seen by additional 1″ absorbers, and the effects of in-line voids can be minimized. Scans were taken of rabbit kidneys and bileary tracts as an iodated contrast agent was infused, and of rabbit lungs while the animal breathed a xenon/oxygen mixture. Future directions for this technique of transmission scanning are discussed. (auth)

5683 SOME APPLICATIONS OF Si(Li) DETECTORS TO CLINICAL PROBLEMS. Kaufman, L.; Nelson, J.; Price, D.; Shames, D.; Wilson, C. J. (Univ. of California, San Francisco). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 402-410(Feb 1973).

The replacement of conventional clinical techniques and the development of new techniques using solid state detectors are discussed. Work presented here includes a simplified (geometry and counting-time independent) method for in-vitro iodine and bromine determinations, in-vivo iodine measurements through a tissue absorption correction based on the ratio of K_α to K_β radiation, cardiac output studies, and evaluation of absorptive characteristics of cerebral ventricles. (auth)

5684 DEVELOPMENT OF A SIX ELEMENT HIGH PURITY GERMANIUM DETECTOR ARRAY FOR CEREBRAL BLOOD FLOW STUDIES: THE PROTOTYPE OF A 144 ELEMENT SYSTEM. Marler, J. M. (General Electric Co., Philadelphia); Gelezunas, V. L.; Barker, J. N.; Youdin, M.; Reich, T. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 411-414(Feb 1973).

A six element, high purity germanium (HPGe) detector array has been designed, constructed and tested as the prototype of a 144 element, multiplanar detector array for local cerebral blood flow measurements in 144 subdivisions of the human brain using ^{133}Xe. The design requirements of the detection system are discussed relative to the brain "block" model, the photon energy range, and other available photon detectors. The characteristics and performance of the prototype array are described as well as the advantages of HPGe detectors for applications in nuclear medicine and large arrays. (auth)

5685 PERFORMANCE OF A PRESSURIZED XENON-FILLED MULTIWIRE PROPORTIONAL CHAMBER. Kaufman, L.; Perez-Mendez, V.; Stoker, G. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 426-428(Feb 1973).

The performance of a multiwire proportional chamber filled with xenon (93% Xe, 7% CO_2) to a pressure of 60 psi absolute is described. The readout is by the electromagnetic delay line method. Measurements taken at 60 keV and 140 keV show that 1 mm and 2 mm lead grid patterns can be resolved. MTF curves are given for both these energies and the projected performance for clinical work with ^{99}Tc is described. (auth)

5686 INITIAL IMAGES FROM A 24-WIRE LIQUID XENON γ CAMERA. Zaklad, H.; Derenzo, S. E.; Muller, R. A.; Smits, R. G. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 429-431(Feb 1973).

A prototype liquid xenon γ-camera has been constructed and preliminary results obtained. The sensitive volume is 7 cm × 7 cm in area and 1.5 cm thick. Orthogonal coordinates for each interacting γ-ray are provided by 24 anode wires 5 μ in diameter spaced 2.8 mm apart and 24 cathode strips. (auth)

5687 PRECISION MEASUREMENTS OF THE IONIZATION ENERGY AND ITS TEMPERATURE VARIATION IN HIGH PURITY SILICON RADIATION DETECTORS. Ryan, R. D. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 473-480(Feb 1973).

High precision absolute measurements of the ionization energy (ϵ) for alpha particles and electrons have been made in two thick high purity silicon guard ring detectors between 100 and 250°K. At a fixed energy (E) both ϵ_α and ϵ_{e-} were found to vary linearly ($r = 0.999$) with the band gap (W_G). ϵ_α and ϵ_{e-} also increased with E and $\epsilon_{e-} \neq \epsilon_\alpha$. The slope $(\Delta\epsilon_a/\Delta W_G) = 1.83 \pm 0.04$ is the lowest so far reported and is in closer agreement with Drummond and Moll's theoretical value of 1.73. However $(\Delta\epsilon_e-/\Delta W_G) = 2.87 \pm 0.07$ is significantly higher. (auth)

5688 DISTRIBUTION OF DONORS AND ACCEPTORS IN HIGH-PURITY GERMANIUM CRYSTALS. Haller, E. E.; Hansen, W. L.; Goulding, F. S. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 481-487(Feb 1973).

The axial and radial dependence of the net-concentrations of donors and acceptors in high-purity germanium has been investigated. The methods include dc-conductivity measurements on Czochralski grown crystals, Hall effect experiments on full area slices, collimated alpha particle probing on detectors, and C-V measurements on detector arrays. Some quantitative correlations between the results of the different methods are presented. Many of the crystals exhibit internal junctions, whose influence on the properties of high-purity germanium detectors is discussed. (auth)

5689 COLLIMATED BEAM SCANNING OF PURE GERMANIUM DETECTORS. Baertsch, R. D. (General Electric Co. Research and Development, Schenectady, NY). Contract AT(11-1)-3193. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 488-493(Feb 1973).

The design of collimated sources of ^{241}Am, ^{57}Co, and ^{55}Fe suitable for scanning germanium detectors is given. ^{241}Am scans taken through the p contact on a p-type detector are given for detectors with and without radial resistivity gradients. The data obtained from these scans are used to calculate the radial dependence of depletion layer width and an "effective" carrier concentration. The results obtained indicate that with the surface treatment used the surface is accumulated on p-type detectors. At voltages below full depletion, an extra "peak" associated with slow pulses originating in the undepleted region is described. The number of these slow pulses depends on the type of back contract that is used. (auth)

5690 OPERATIONAL CHARACTERISTICS OF GERMANIUM DETECTORS AT HIGHER TEMPERATURES. Pehl, R. H.; Haller, E. E.; Cordi, R. C. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 494-499 (Feb 1973).

Several important areas for the use of germanium spectrometers would be opened if these detectors could be successfully operated at temperatures considerably in excess of 77°K. Precise measurements on a series of detectors made from different high-purity germanium crystals and on one lithium-drifted germanium detector indicate that the resolution does not degrade significantly until nearly 150°K is reached. Similar-sized detectors, including the lithium-drifted device, exhibited essentially identical temperature-resolution relationships. (auth)

5691 COMPARISON OF TWO TYPES OF AMPLIFYING RADIATION DETECTOR FOR USE IN PORTABLE GAMMA RADIATION MONITORS. Jones, A. R. (Atomic Energy of Canada Ltd., Chalk River, Ont.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 528-533(Feb 1973).

Comparative measurements have been made on bevelled and reach-through silicon junction amplifying detectors. The γ-ray sensitivity of the reach-through diode depends much less on bias voltage and temperature. It has a low operating bias, typically 200 volts, and a plateau of at least 100 volts. (auth)

5692 DEAD LAYERS IN CHARGED-PARTICLE DETECTORS. Elad, E.; Inskeep, C. N.; Sareen, R. A.; Nestor, P. (ORTEC, Inc., Oak Ridge, TN). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 534-544(Feb 1973).

The results of dead-layer thickness measurements on silicon surface-barrier and ion-implanted detectors are presented, and a comparison of various methods for measuring dead-layer thicknesses is given. The experimental arrangement and estimates of experimental error are discussed. Data on dead-layer thicknesses of n-type and p-type surface-barrier detectors and boron-implanted position-sensitive detectors are given. A linear relation was observed between the dead-layer thickness and the metal electrode thickness for both the rectifying and ohmic contact of barrier detectors. The thinnest dead layers measured were 270 Å (silicon equivalent) for 15 $\mu g/cm^2$ of gold and 460 Å (silicon equivalent) for 6 $\mu g/cm^2$ of aluminum. (auth)

5693 THIN-FILM THERMOPILE MATRIX FOR DETECTING PULSED RADIATION. Ciarlo, D. R.; Brown, H. A.; Boster, T. A.; Blake, D. A. (Univ. of California, Livermore). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 545-548(Feb 1973).

A thin-film thermopile matrix is vacuum deposited on a glass substrate. Nickel and copper thin films are used for the two junction materials. A total of 400 junctions are deposited over an area 2.2 cm by 2.2 cm, corresponding to a junction density of 82 junctions/cm^2. Half of these junctions are hot junctions and the other half are reference junctions. The reference junctions are shielded from the incoming pulsed radiation by a 0.05-cm-thick gold shield. All junction pairs are series connected so that the thermal emf's add. An output voltage of 0.1 mV per junction pair is obtained when the device is illuminated with a 1.5-msec pulse from a 1-kV xenon flash tube. The output voltage from an individually wired, Chromel-constantan thermopile is 0.2 mV per junction pair when the thermopile is illuminated with an identical pulse. (auth)

5694 MONTE-CARLO CALCULATION OF THE NEUTRON SENSITIVITY OF SELF-POWERED DETECTORS. Goldstein, N. P. (Westinghouse Research Labs., Pittsburgh). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 549-556 (Feb 1973).

Self-powered (s-p) detectors are useful for incore neutron measurements in nuclear reactors because of their small size, ruggedness and simplicity. In one type of detector, a delayed current results from the beta activity induced in the device by the neutron flux while a second type gives an instantaneous response due to the Compton electrons produced by the gammas released following the capture of neutrons in the device. To test these physical models and more importantly, to point the way to improvements in design without having to resort to excessive experimentation, a Monte-Carlo model was constructed to allow computations to be made of the response of both types of detector. The calculations were performed for Rh and V delayed and Co instantaneous detectors with emitter diameters of .051 cm and insulator thickness of .025 cm in all cases. The agreement with experiment was fairly good and the small discrepancies which occur are discussed. (auth)

5695 PLATINUM IN-CORE FLUX DETECTOR. Shields, R. B. (Atomic Energy of Canada Ltd., Chalk River, Ont.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 603-608(Feb 1973).

The use of platinum as the emitter in a self-powered flux detector produces a mixed neutron and gamma sensitivity, but typically a higher proportion of prompt response, that is maintained throughout life, than for earlier types. The detector described has a high output and low burnup rate, confirmed by two years of extensive tests at high flux. (auth)

5696 NEW GAS SCINTILLATION DETECTOR FOR FAST REACTORS. Handschuh, J.; Walters, R. A.; Schneider, R. T.; Carroll, E. E. Jr. (Univ. of Florida, Gainesville). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 633-638 (Feb 1973).

A gaseous scintillator which features gamma ray and system noise suppression has been studied for possible use in high power density breeder reactors. Spectroscopic information on the light emitted from several gases under fission fragment excitation has been obtained. This information is also useful for the nuclear pumped laser concept. Performance characteristics of a prototype detector at thermal neutron fluxes up to 2×10^{12} n/cm^2-sec have been obtained and advantages of the concept are discussed. (auth)

5697 GAMMA COMPENSATED PULSED IONIZATION CHAMBER WIDE RANGE NEUTRON/REACTOR POWER MEASUREMENT SYSTEM. Ellis, W. H.; Cooper, J. L. Jr.; Sanders, G. H. (Univ. of Florida, Gainesville). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 639-648(Feb 1973).

A newly developed pulsed mode of operation of ionization chambers, and the use of neon as an additive to the primary helium fill gas, has demonstrated a wide range capability for neutron flux and reactor power measurements over eight orders of magnitude, independence of high temperature insulator leakage and ionized gas kinetics effects, freedom from recombination effects, and a capability for 99% compensation for gamma fields of approximately 10^5 (R/hr) and higher. A single sensor compensated neutron flux/reactor power measurement system, based on the PIC mode of operation, is proposed that has an inherent linear measurement capability extending over 18 decades of neutron flux density, from approximately 10^{-2} to 10^{16} nv. (auth)

5698 NON-PHOTOGRAPHIC REGISTRATION OF NUCLEAR TRACKS IN SOLIDS AND THEIR APPLICATIONS. Piesch, E. (Kernforschungszentrum, Karlsruhe, Ger.). G-I-T (Glas-Instrum.-Tech.) Fachz. Lab.; 16: No. 7, 810-816(1972). (In German).

A survey is given of the mode of detection, the method, and the following applications: neutron dosimetry, autoradiography, microanalysis, geologic age determination, cosmic radiation measurement, and determination of uranium enrichment. (GF)

5699 VARIABLE DETECTOR MOUNTING ASSEMBLY FOR SILICON SURFACE BARRIER DETECTORS. Quast, U.; Nocken, U. (Ruhr Univ., Bochum, Ger.). Nucl. Instrum. Methods; 109: No. 2, 407-408(1973).

A versatile detector mounting assembly for silicon surface barrier detectors in scattering chambers is described. (auth)

5700 TABLES OF DETECTION EFFICIENCIES OF CZECHOSLOVAK NaI(Tl) SCINTILLATORS MANUFACTURED BY VUPJT PREMYSLENI NEAR PRAGUE. Petr, I. Jad. Energ.; 19: No. 4, 132-134(Apr 1973). (In Czech).

The detection efficiencies of standard-size scintillators in a parallel beam or isotropic field of gamma rays are given. (auth)

5701 INFLUENCE OF DISTANCE OF THE SOURCE AND THE CHANGES OF PRINCIPAL PARAMETERS ON THE SENSITIVITY OF THE GMT 30/30 AB RADIOMETER. Silar, J.; Binova, M. (Charles Univ., Prague). Jad. Energ.; 19: No. 4, 125-131 (Apr 1973). (In Czech).

The influence of the distance of a ^{90}Sr + ^{90}Y source to the window and the influence of the effective anode length of a 30/30 AB—type GM—tube on the sensitivity of a radiometer during operation has been studied. The dependence of the counting rate on the spectrum shape and the resulting counting losses of different discrimination levels has been investigated. (auth)

5702 INCOMPATIBILITY OF COMMERCIAL TISSUE SOLUBILIZER WITH THE LIQUID SCINTILLATION FLUOR BUTYL-PBD. Painter, K.; Gezing, M. J. (Amersham/Searle Corp., Arlington Heights, IL). Int. J. Appl. Radiat. Isotop.; 24: No. 6, 361(Jun 1973).

Results are given which confirm those of earlier investigators that butyl-PBD should not be used in combination with commercial quaternary ammonium hydroxide tissue dissolving reagents such as Protosol and Hyamine hydroxide. It appears that the fluor of choice for these applications is PPO. (UK)

5703 SPURIOUS PULSES IN PROPORTIONAL COUNTERS FILLED WITH TISSUE EQUIVALENT GAS. Campion, P. J.; Burke, M. (National Physical Lab., Teddington, Eng.). Int. J. Appl. Radiat. Isotop.; 24: No. 6, 355-357(Jun 1973).

The time distribution of spurious pulses is reported in proportional counters filled with 64.4% methane, 32.4% carbon dioxide and 3.2% nitrogen, a mixture which is frequently referred to as a tissue equivalent gas. Time distributions for 600, 300 and 50 torr pressures of tissue equivalent gas are given with counter voltages of 3.35, 2.65 and 1.625 kV respectively. An anomalous effect occurred which manifested itself as a double peak in a spectrum in which only one peak would normally be expected. This effect disappeared below about 200 to 300 torr. The origin of this spurious effect is discussed and it is stated that although there are indications that it may be due to a streamer mechanism no detailed explanation has yet been proposed and it is therefore unwise to speculate on the mechanism by which spurious pulses may be generated in anomalous type discharges. (UK)

5704 SOLID-ANGLE CORRECTION FACTORS FOR FIVE-SIDED COAXIAL Ge(Li) DETECTORS. Krane, K. S. (Univ. of California, Berkeley). Nucl. Instrum. Methods; 109: No. 2, 401-402(1973).

A previous method for the calculation of solid-angle correction factors of coaxial Ge(Li) detectors is extended to "five-sided" coaxial detectors, and typical results are presented. (auth)

5705 ABSOLUTE FIELD DISTRIBUTION IN GASEOUS PROPORTIONAL COUNTERS OF BOX-TYPE GEOMETRY. Waligorski, M. P. R. (Jagellonian Univ., Krakow). Nucl. Instrum. Methods; 109: No. 2, 403-405(1973).

Lines of equal absolute field values are calculated and their role in the operation of box-type proportional counters is discussed. (auth)

5706 MONTE CARLO CALCULATIONS OF EFFICIENCY VALUES FOR VARIOUS SOURCE-TO-DETECTOR GEOMETRIES. Holmberg, P.; Rieppo, R.; Blomster, K. (Oulu Univ., Finland). Commentat. Phys.-Math.; 43: No. 1, 21-30(Mar 1973).

A Monte Carlo method for calculating gamma-ray efficiency values for well-type NaI-detectors is described. The influence of minor changes in absorption coefficients as well as detector and well dimensions are discussed. The efficiency values calculated for a 1 ¾″ × 2″ NaI detector (well diameter 16 mm, depth 39 mm) are given. Extended sources with self-absorption are taken into account. (auth)

5707 SIMPLE METHOD FOR MAKING A FAST INORGANIC SCINTILLATOR SCREEN FOR THE DETECTION OF FISSION FRAGMENTS. Nobes, M. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Instrum. Methods; 109: No. 2, 275-276(1973).

A simple method is described for making a fast inorganic scintillator screen for the detection of fission fragments. A suspension of ZnO: Ga in a solution of collodion in acetone is ultrasonically agitated and deposited upon a thin glass disc. (auth)

5708 LIQUID SCINTILLATORS BASED ON NORMAL ALKANES AND INTERMEDIATE SOLVENTS. Koike, Y. (Tokyo Metropolitan Isotope Research Center). Nucl. Instrum. Methods; 109: No. 2, 269-274(1973).

Relations between pulse height and concentration of intermediate solvents or secondary solvents in liquid scintillator based on normal alkane are experimentally obtained. The normal alkanes used in this study are n-hexane – n-dodecane and the intermediate solvents are naphthalene, its alkyl-derivatives, diphenyl and its derivatives. The pulse heights of the scintillation solution containing intermediate solvents, especially of low concentration, are remarkably enhanced with concentration of the intermediate solvents. Influence of gases on the scintillation solutions is measured by the bubbling technique. Gases such as hydrogen, dinitrogen oxide and gas of ammonia (except oxygen, having strong quenching) have mild quenching. The scintillation process of the solution containing intermediate solvents and quenching phenomena by the dissolved gases in the scintillation solutions are also discussed. (auth)

5709 PROPERTIES OF THE XENON LIQUID-FILLED NUCLEAR DETECTORS. Prunier, J.; Allemand, R.; Laval, M.; Thomas, G. (CEN, Grenoble, France). Nucl. Instrum. Methods; 109: No. 2, 257-264(1973).

Pure liquid xenon has been investigated as a suitable filling material for multiwire proportional chambers (MWPC). The basic parameters frequently used for gases have been derived from ionization chamber and electronic avalanche gain pulse measurements. (auth)

5710 ABSOLUTE EFFICIENCY CALIBRATION OF COAXIAL Ge(Li) DETECTORS FOR THE ENERGY RANGE 160 to 1330 keV. McNelles, L. A.; Campbell, J. L. (Univ. of Guelph, Ont.). Nucl. Instrum. Methods; 109: No. 2, 241-251(1973).

A brief review of efficiency calibration techniques for Ge(Li) detectors is given, and the necessity for precise interpolation between absolute efficiencies measured at specific energies is discussed. Various analytical functions are fitted to experimental absolute efficiency data for a coaxial detector. The limits of validity of the most successful function are explored through measurement of relative gamma ray intensities for several widely used calibration sources. (auth)

5711 EFFECTIVE CENTER OF THE LONG COUNTER. Heinzelmann, M.; Rohloff, F. (Kernforschungsanlage, Juelich, Ger.). Nucl. Instrum. Methods; 109: No. 2, 205-210(1973). (In German).

The position of the effective center of the long counter has been calculated by two-group diffusion equations. The theory was checked by experimental results and found to be reasonably good up to an energy of 4.5 MeV. For higher energies the calculation gives distances from the detector surface to the effective center which are too low in comparison with measurements. Additionally various circumstances are discussed that influence the position of the effective center. (auth)

5712 TRACK-DIAMETER KINETICS IN DIELECTRIC TRACK DETECTORS. Somogyi, G. (Inst. of Nuclear Research, Debrecen, Hungary); Szalay, S. A. Nucl. Instrum. Methods; 109: No. 2, 211-232(1973).

The minor and major axes of track-pits of nuclear particles registered in dielectric soids are gradually varying in the course of the etching process. A general theoretical description of this variation (track-diameter kinetics) is given here for particles entering solids at arbitrary angles. The model has been extended to detectors with both isotropic and anisotropic etching properties. The determination of the formulas describing the variation of etch-pit axes during the etching process are separately discussed for constant and varying track etch rates. The characteristics of the model are illustrated for some particular cases. On the basis of the geometrical model of etch-pit evolution, new methods for the experimental determination of track parameters (track etch rate, entrance angle, range) are proposed. These methods applying to etch-pits of spontaneous fission tracks registered in glass detectors may help, among others, in the search for super-heavy transuranic elements. (auth)

5713 COMPARISON OF PLASTIC SCINTILLATORS WITH NANOSECOND LIFETIMES. Kelly, T. M. (Eastman Kodak Co., Rochester, NY); Merrigan, J. A.; Lambrecht, R. M. Nucl. Instrum. Methods; 109: No. 2, 233-235(1973).

The scintillation lifetimes of Pilot U, M and B, Naton 136, NE 111 and an experimental scintillator are compared. The new Pilot U scintillator exhibits the fastest decay time (τ_1 = 1.36 ns) yet obtained for a plastic scintillator. (auth)

5714 TEMPERATURE DEPENDENCE OF THE OUTPUT CURRENT FROM A GAMMA-COMPENSATED IONIZATION CHAMBER. Fukuda, K.; Okabe, S. (Radiation Center of Osaka Prefecture, Sakai, Japan). Nucl. Instrum. Methods; 109: No. 2, 305-311(1973).

The effect of temperature on the output current from a gamma-compensated ionization chamber has been investigated in intense gamma-fields within the temperatures ranging from 15 to 180°C. Remarkable variations of the output current have been observed with changing temperature. Thermally stimulated exo-electron emission from the chamber wall and the boron film coated on the electrodes of the chamber is discussed as one of the possible causes of the variations. (auth)

5715 RESPONSE OF THIN FILM SCINTILLATOR DETECTOR TO LIGHT AND HEAVY IONS. Muga, L.; Griffith, G. (Univ. of Florida, Gainesville). Nucl. Instrum. Methods; 109: No. 2, 289-295(1973).

The response of the thin film detector (TFD) to transiting light ions (Z = 1,2) and fully stopped light and heavy ions (Z = 1,2,7,8) is reported. Response features distinct to these ions are described for various thin film thicknesses as a function of incident ion energy and velocity. The TFD response is shown to depend predominantly on two factors, namely, the velocity and atomic number Z of the transiting ion. The specific luminescence recorded as a function of specific energy loss is in conflict with previously reported work near maximum dE/dx values. The new trend observed suggests the double-valued nature of specific luminescence when plotted vs specific energy loss. The Z dependence of the luminescence saturation effect is confirmed. (auth)

5716 SIMULTANEOUS STORAGE OF SPECTRA AND ADDITIONAL SIGNALS BY A MULTICHANNEL SPECTROMETER. Goerner, W.; Rost, A. (Central Inst. of Nuclear Research, Dresden). Nucl. Instrum. Methods; 109: No. 2, 297-300(1973).

A special translator feeds several rates of additional (clock-time, life-time, control or monitor) pulses into reserved channels of the corresponding energy spectrum. Two versions of the device are dealt with. Their counting losses are studied by the help of a Monte Carlo program. Among the possible cases of application a combined correction of irradiation dose, cooling, and dead-time affected measurement in activation analysis is regarded more closely. (auth)

5717 CALCULATION OF THE RELATIVE COUNTING RATE OF A WELL TYPE SODIUM IODIDE SCINTILLATION CRYSTAL IN ISOTOPIC NEUTRON SOURCE ACTIVATION ANALYSIS. Lindfors, B. (Technical Research Centre of Finland, Otaniemi). Nucl. Instrum. Methods; 109: No. 2, 317-326(1973).

Calculations of the relative counting rates of ϕ 5″ × 5″ sodium iodide well detectors have been made for samples activated with an isotopic neutron source. The study was undertaken in order to determine the most efficient source, sample and detector combination for a NA analyzer, which will be used to assay the Si-contents of the output from a ferrochrome smelting furnace. Hence only one energy of the gamma rays, 1.78 MeV, corresponding to the energy of ^{28}Al which is formed by the reaction ^{28}Si(n,p)^{28}Al in the bombardment with fast neutrons, has been considered. The counting rate has, however, been studied as a function of various parameters, e.g. the neutron source dimensions and the emission rate of the source, sample dimensions, and the radius and depth of the crystal well. The calculation is divided into two parts; calculation of the activity of the sample and evaluation of the detection efficiency of the crystal. The sample activity is calculated using Romberg's method for numerical quadrature. No absorption of the neutrons in the neutron source, its steel encapsulation or in the sample holder and the sample material, is taken into consideration. The detector efficiency is evaluated using a Monte Carlo program, and the attenuation of the gamma photons by the sample is considered. (auth)

5718 TOTAL CROSS SECTION MEASUREMENTS BY X-RAY DETECTION OF ELECTRON-CAPTURE RESIDUAL ACTIVITY. Chang, C. N.; Kent, J. J.; Morgan, J. F.; Blatt, S. L. (Ohio State Univ., Columbus). Nucl. Instrum. Methods; 109: No. 2, 327-331 (1973).

A method is presented for measuring total cross-sections for reactions producing final nuclei which decay by electron capture. The method involves the detection of the X-rays from the atom produced by the electron capture, by use of a Si(Li) detector. As an example, results are presented for the total cross section of the reaction ^{48}Ti(α,n)^{51}Cr in the bombarding energy range 5.0 to 11.0 MeV. (auth)

5719 CALCULATION OF THE RESPONSE FUNCTION OF SEMICONDUCTOR PROTON RECOIL COUNTERS WITH A RADIATOR OF FINITE THICKNESS. Gotoh, H.; Yagi, H.; Harayama, Y. (Japan Atomic Energy Research Inst., Tokai). Nucl. Instrum. Methods; 109: No. 2, 349-353(1973).

A calculation formula for the response function of semiconductor proton recoil counters with a radiator of finite thickness exposed to a parallel neutron beam is expressed in a single integral form with an elementary function as integrand. Numerical examples of the response function calculation are also given. (auth)

Radiation Dosimeters

Refer also to abstract 5553.

5720 (AD-752224) FRICKE DOSIMETER BEHAVIOR WITH AND WITHOUT SODIUM CHLORIDE AND AT DOSES ABOVE 40 KILORADS. Report for 1 February–15 May 1972. Hardy, K. A.; Witschy, J. K. (School of Aerospace Medicine, Brooks AFB, Tex.). Nov 1972. 14p. (SAM-TR-72-21). NTIS.

An extension of the upper limit for radiation doses measured with the standard Fricke dosimeter system was observed in measurements performed at 25°C. The study included doses as high as 75 to 80 krad. No significant difference in response could be detected between the solution containing sodium chloride and otherwise identical solutions without sodium chloride, for exposures to ^{60}Co gamma radiation at 1000 rad/min. and to 6 MeV electrons produced by a linear accelerator with intrapulse rates on the order of 10 to the 7th power rad/sec. (auth)

5721 (CLOR–92) AUTOMATIC METHODS OF CONTINUOUS MEASUREMENT OF EARTH GAMMA BACKGROUND EXPOSURE DOSE. Pensko, J.; Jagielak, J.; Gwiazdowski, B.; Zak, A. (Centralne Laboratorium Ochrony Radiologicznej, Warsaw (Poland)). 1972. 42p. (In Polish). Dep. NTIS (U. S. Sales Only) $4.25.

Methods and instruments for continuous measurement of terrestrial gamma background radiation exposure doses developed in CLOR are described. The measuring equipment has been designed by using G.M. counters and high pressure ionization chambers. The calibration methods which take into account the complex character of the geometry of measurement and wide energy spectrum of gamma photons of this kind of radiation source are presented. Some examples of the measurements and observations results are also given. (auth)

5722 (NP–19722) CHEMICAL DOSIMETERS IN AQUEOUS SOLUTIONS. Tugsavul, A.; Uenseren, E. (Cekmece Nuclear Research and Training Center, Istanbul (Turkey)). 1972. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

The development and uses of simple chemical dosimeters in aqueous solutions that do not require complicated equipment and rare expensive initial materials are described. The review covers dose determinations for electrons, gamma radiation, and x rays. (TFD)

5723 WARNING AGAINST HIGH ENERGY β-EMITTERS IN LIGHT SOURCES FOR TL-READERS. Spanne, P. (Linkoepings Hoegskola, Sweden). Health Phys.; 24: No. 5, 568-569(May 1973).

An error in the dosimeter readings and an increase of the background signal in a thermoluminescent readout instrument caused by the reference light source, supplied to check the overall sensitivity of the readout system, is reported. The reference light source consists of a plastic phosphor and a ^{90}Sr/^{90}Y source (E_{max} = 2.27 MeV). In the silica window, which is heated during readout, a signal is induced when the light source is in the measuring position for 1 min, equivalent to that from a LiF–teflon dosimeter irradiated by ^{60}Co γ rays to an absorbed dose of 200 mrad. Exposing the silica window to the light source for 2 min increases the background signal to three times its initial value. With a ^{14}C source (E_{max} = 155 keV) no significant background signal is observed. (UK)

5724 HEALTH PHYSICS INSTRUMENTATION AND MEASURING TECHNIQUES. Second Edition. Oberhofer, M. Thiemig-Taschenbuecher, No. 6. Munich; Thiemig (1972). 298p. (In German).

This volume gives an introduction to radiation measurement techniques and a survey of the most important measuring procedures and instruments presently used in practical radiation protection. Some chapters on neutron dosimetry and solid-state dosimetry have been added. The chapter on leak testing of sealed radiation sources has also been supplemented. (GE)

5725 DIFFERENTIAL STAGE HAVING A HIGH INPUT IMPEDANCE FOR INVESTIGATING THERMOLUMINESCENCE. Kudelin, K. M.; Zabrodskaya, L. Ya. (State Scientific-Research Inst. of Metrology, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1128-1129(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 137-138(1972).

A circuit is described for a differential stage having a high input impedance, which is used in investigating a thermoluminescence signal. The possibility of simultaneous reading of the amplitude and the derivatives of the thermal deexcitation curve is considered. (auth)

5726 DOSIMETRY IN ON-LINE OPERATION WITH A PROCESS COMPUTER. Leetz, H. K. (Univ. des Saarlandes, Hamburg, Ger.). Strahlentherapie; 145: No. 3, 299-304(1973). (In German).

For some years, dosimetry has been done with an ionization chamber in the water phantom in on-line operation with a digital process computer. The measuring arrangement and the programming are described. Some examples of measuring results are reported. (GE)

5727 LONG-TERM COMPARISON OF GLASS DOSIMETERS AND POCKET ELECTROMETERS UNDER PRACTICAL CONDITIONS. Ewen, K.; Erlenbach, H. R. (Zentralstella fuer Sicherheitstechnik des Landes Nordrhein-Westfalen, Duesseldorf, Ger.). Health Phys.; 24: No. 6, 679-680(Jun 1973).

Radiation exposures to individuals from two reference groups were assessed and compared using both silver-activated metaphosphate glass dosimeters and pen-type direct reading pocket electrometers. The number of participants, length of test, type of employment of participants, position of wearing dosimeters and the types of radiation encountered are enumerated. The glass dosimeter readings are compared with the corresponding pocket electrometer readings for the two groups. A normal distribution of these values is shown, from the half width of which a value of a standard deviation of 20% was found. Considering the sole use of glass dosimeters and pocket electrometers for routine monitoring of radiation workers, the agreement of the obtained dose readings appears to be quite good. (UK)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 5198, 6456, and 7421.

5728 (AD-755789) ACCIDENTAL COINCIDENCES IN THE ELECTRON SPECTROMETER ON SATELLITE OV1-13. Kelley, J. G. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 10 Oct 1972. 25p. (AFCRL-72-592; AFCRL-PSRP-513). NTIS.

Low energy particles incident on the front detector in coincidence with the penetration of high energy particles through the side of this instrument to its rear detector may cause significant error in the fluxes recorded. In order to determine the severity of such errors, the probability of such accidentals is calculated and evaluated using the highest expected fluxes that will contribute to it. These results are then applied to data obtained from OV1-13. It is found that significant error is possible only near L = 1.4. In this region the erroneous flux recorded in any channel is never greater than the total flux recorded in the highest energy (lowest flux) channel. Subtraction of the flux (if any) recorded in this highest energy channel from that recorded in each of the other channels will produce an improved spectrum. (auth)

5729 (AD–755790) CALIBRATION OF A MAGNETIC SPECTROMETER DESIGNED TO MEASURE 0.1 TO 1.0-MeV ELECTRONS IN SPACE. Rothwell, P. L.; Moomey, W. R. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 6 Dec 1972. 27p. (AFCRL–72–710; AFCRL-PSRP–516). NTIS.

The recalibration of a magnetic spectrometer designed to measure the 0.1 to 1.0-MeV electron flux in a space environment is described. A different technique from that of the original calibration was used. In the present case, a Monte Carlo computer program and beta source measurements are used to determine the detected energies and their detection efficiencies. The mean energies were 20 to 40 keV higher and the normalizations were a factor of two higher than those previously found. Systematic errors effects and the degree of elastic scattering off the magnet faces are analyzed. (auth)

5730 (CONF-730119–1) GAMMA-RAY ENERGIES MEASURED WITH Ge(Li) SPECTROMETERS. Helmer, R. G.; Greenwood, R. C.; Gehrke, R. J. (Aerojet Nuclear Co., Idaho Falls, Idaho). 1973. 23p. Dep. NTIS $3.25.

From American Physical Society meeting; New York, New York, USA (29 Jan 1973).

The capability of spectrometers using Ge(Li) detectors for the precise measurement of gamma-ray energies up to 3 MeV is discussed. (TFD)

5731 (COO-3130-TB-167) SPEX (SPECTROMETER EXECUTIVE): GENERAL STRUCTURE. Massimo, J. T.; Nelson, B. A.; Levinson, L. J. (Brown Univ., Providence, R. I. Dept. of Physics). Aug 1972. Contract AT(11-1)-3130-TB. 18p. Dep. NTIS $3.00.

SPEX, a software system designed to support data acquisition and on-line analysis on a PDP-11 with at least 12K of core and a disk, is described. Core management, disk management, SPEX queues and the node pool, the system task list and the active task list, and significant events and the ATL scan are discussed. (WHK)

5732 (JINR-P10-7061) PROGRAMS FOR PRELIMINARY PROCESSING OF SPECTROMETRICAL INFORMATION ON THE COMPUTER "MINSK-2" USING DISPLAY. Vylova, L.; Potempa, M.; Fominykh, V. I.; Fominykh, M. I.; Tsupko Sitnikov, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 23p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

The description of the programs which allow the conducting of different kinds of preliminary express-processing of spectrometrical information and to prepare basic data for the most complete processing on the computer BESM-6 is given. Fast operator-computer connection combined with the possibility to observe the content of information under processing is gained by connecting the oscillographic display with the computer. (auth)

5733 (LA–5187) VELOCITY DISTRIBUTIONS BY CORRELATION TECHNIQUES. Allen, L. D. F. (Los Alamos Scientific Lab., N. Mex.). Apr 1973. Contract W-7405-eng-36. 10p. Dep. NTIS $3.00.

Correlation techniques as applied to the velocity analysis of particle beams are reviewed. The apparatus and the data-reducing system used in a crossed-molecular-beams experiment are described. (auth)

5734 (LBL-1616) NONDISPERSIVE SOFT X-RAY FLUORESCENCE SPECTROMETER FOR QUANTITATIVE ANALYSIS OF THE MAJOR ELEMENTS IN ROCKS AND MINERALS. Hebert, A. J.; Street, K. Jr. (California Univ., Berkeley. Lawrence Berkeley Lab.). Apr 1973. Contract W-7405-eng-48. 26p. Dep. NTIS $4.00.

A lithium-drifted silicon detector and a multichannel analyzer system have been combined with a multiple anode soft x-ray generator and a high vacuum sample handling system to provide an x-ray fluorescence unit for quantitative analyses of the elements from oxygen to iron. A relatively rapid, accurate, and reproducible sample preparation technique and a method for sample matrix absorption corrections are described. (auth)

5735 (LBL-1719) DEVELOPMENT OF A NEUTRON SPECTROMETER USING MULTI-WIRE SPARK CHAMBERS FOR THE MEASUREMENT OF THE SPECTRA OF STRAY NEUTRONS IN THE VICINITY OF HIGH ENERGY ACCELERATORS. Lim, C. B. (California Univ., Berkeley. Lawrence Berkeley Lab.). Jan 1973. Contract W-7405-eng-48. 166p. Dep. NTIS $10.50. Thesis.

A method of neutron spectrometry which measures the energy spectra of the stray neutrons around the high energy accelerators, roughly between 50 MeV and 300 MeV, has been developed using a series of multi-wire spark chambers and polyethylene n-p converters. The method is based on the proton producing, neutron induced reactions in the converting medium and the measurement of the proton track lengths with the spark chambers. The proton energy spectrum is constructed from the collected proton track events, and later an incident neutron energy spectrum is unfolded numerically from this proton energy spectrum by solving the integral equation connecting the two quantities in the spectrometer volume using the least squares method. For this method, 12 spark chambers with a sensitive area 50 × 50 cm^2 have been designed and constructed. The spectrometer was assembled with all the related electronics and its various performances were tested. The proton producing reactions and the particle transport behavior in the detector volume have been thoroughly analyzed. An approximate integral relation connecting the incident neutron energy spectrum and the detected proton energy spectrum has been established in the above energy region. In the evaluation of the kernel matrix needed in the neutron unfolding process a random sampling technique was utilized. Finally, the performances of the whole spectrometer set-up and the related neutron unfolding technique have been tested with the measurement of stray neutrons in the 100 MeV region around the 184-Inch Cyclotron at the Lawrence Berkeley Laboratory. (auth)

5736 (RT/FI-(72)55) INTERPRETATION OF THE RESULTS OF UNFOLDING OF NEUTRON SPECTRA OBTAINED WITH SPECTRA CODE. Arcipiani, B. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 20 Dec 1972. 51p. (In Italian). Dep. NTIS (U. S. Sales Only) $4.75.

The SPECTRA code, in its LIMIT operation mode, leads to a result which may be interpreted as the convolution of the unknown spectrum with a kernel depending on the approximate spectrum, the foil detectors, and the unfolding method. The properties of the kernel show that the activation data modify the approximate spectrum by amounts for which quite often a physical meaning cannot be ascertained at single energy values. It is thus confirmed that the validity of the final spectrum strongly relies on the approximate spectrum. (auth)

5737 USE OF GOLD AS BACKSCATTER ABSORBER IN MULTIDIMENSIONAL GAMMA-RAY SPECTROMETERS. Brodzinski, R. L. (Pacific Northwest Lab., Richland, WA). Radiochem. Radioanal. Lett.; 13: No. 5-6, 375-380(30 Apr 1973).

Compton scattered photons in large crystal multiparameter spectrometers which enter more than one primary detector may be erroneously recorded as coincident events. The fabrication of a gold backscatter absorber to inhibit this background increase and the improved sensitivities obtained with its use are discussed. (auth)

5738 LINEAR FILTER FOR OPERATION UNDER CONDITIONS OF INCREASED LOADINGS. Mitin, A. A.; Sofiev, G. N. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 1115-1117(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 126-128(1972).

A simple linear filter is described which makes it possible to obtain (a) a good signal-to-noise ratio that is characteristic of single differentiation using a delay line, and (b) low distortion of the nuclear spectra under conditions of increased loadings which is inherent in filters having double differentiation of the signal. Results are discussed for the cobalt-60 gamma spectra taken with a Ge(Li) detector. (auth)

5739 LINEAR ADDING CIRCUIT FOR SEMICONDUCTOR Ge(Li)-DETECTORS. Aloev, A. S.; Vartanov, N. A.; Kazakov, Yu. E.; Stugarev, Yu. N. (Inst. of Applied Geophysics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 1082-1084(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 100-102(1972).

A transistor circuit for the linear addition of pulses from two semiconductor Ge(Li)-detectors which operate in a 4π spectrometer mode is described. The circuit has a high linearity throughout the entire amplitude range of the summed pulses. The serviceability of the circuit is checked using the example of obtaining the resultant $4\pi-\gamma$ spectrum of the ^{22}Na isotope. (auth)

5740 SHAPE OF THE LINE FROM A ^{4}He COUNTER FOR NEUTRONS HAVING ENERGIES OF 1 TO 20 MeV. Andreeva, L. S.; Savinskii, A. K.; Filyushkin, I. V.; Chernova, O. N. (Inst. of Biophysics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 1046-1048(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 70-72(1972).

Analytic formulas are presented which allow the shape of the line (the spectrum of energy releases for various neutron energies) to be calculated for a spherical proportional ^{4}He counter with allowance for the finite dimensions of the sensing volume and the energy resolution of the detector. (auth)

5741 CIRCUIT FOR AUTOMATIC CONTROL OF MOVABLE SHIELDING. Golovin, A. E.; Naumov, I. V. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 1014(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 42-43(1972).

A relay servosystem is described for the remote control of the position of spectrometer shielding. The angular-discrepancy error in less than 3°. (auth)

5742 PRECISION ELECTRONIC BLOCK FOR CONTROLLING THE MOVING SYSTEM OF A MOESSBAUER SPECTROMETER. Aleshin, K. P.; Artem'ev, A. N.; Stepanov, E. P. (Inst. of Atomic Energy, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 1029-1032(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 54-57(1972).

A precision electronic block for controlling the electrodynamic moving system of a Möessbauer spectrometer with independent formation of the driving signal and correcting feedback is described. The network operates in a constant-acceleration mode and ensures a velocity range up to 30 cm/sec. At low velocities (~1 cm/sec) it is admissible to use vibrators having various constructions. The network allows compensation of the nonideality of the vibrator-speed meter. The nonlinearity of the velocity, which is determined by means of a multiline Möessbauer spectrometer, amounts to ~0.02%. (auth)

5743 PROPORTIONAL COUNTER BASED ON ^{83}Kr FOR MÖESSBAUER RESEARCH. Ekimov, S. P.; Karasev, V. V.; Khrizhanskii, L. M.; Cherezov, N. K.; Yutlandov, I. A. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 1025-1028(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 51-54(1972).

It has been shown that the accuracy of measuring the amplitude of resonance absorption may be increased by at least a factor of two when the gas proportional counter in Möessbauer experiments with the ^{83}Kr isotope is filled with an $(Ar + Ne + CH_4)$ mixture. The efficiency of the recording x radiation and soft γ radiation in the 6- to 15-keV energy range has been investigated. (auth)

5744 MÖESSBAUER SPECTROMETER FOR ENERGY ANALYSIS OF SCATTERED RADIATION. Artem'ev, A. N.; Aleshin, K. P.; Sklyarevskii, V. S.; Stepanov, E. P. (Inst. of Atomic Energy, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 1022-1024(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 48-51(1972).

A Möessbauer spectrometer for the energy analysis of scattered radiation by means of an absorber-analyzer that moves with a constant acceleration is described. The source moves at a constant velocity corresponding to the excitation of a chosen nuclear transition in the scatterer. The information is stored in a multichannel analyzer. An even base line of the spectrum in the absence of the effect is ensured by missed synchronization of the motion of the source and the absorber-analyzer. (auth)

5745 INVESTIGATION OF THE TIME CHARACTERISTICS OF SCINTILLATION GAMMA-SPECTROMETERS. Andreev, E. A.; Sit'ko, S. D.; Shevchenko, V. A.; Shrivastava, B. K. (Kiev State Univ.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 1011-1013(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 40-42(1972).

The passage of a nanosecond light flash through a spectrometric photomultiplier was investigated. The dependence of the time required for passage of the signal through an FÉU-13 or FÉU-49 on the distance between the center of the photocathode and the location of the illumination was obtained. Using the current signals from the anode of the photomultiplier and takeoff via the spectrometric channel ($E_\gamma > 100$ keV) for time locking, a time resolution of 3 nsec was obtained for an FÉU-13 with a 40 × 40-mm crystal, while a value of at most 4.5 nsec was obtained for an FÉU-49 with a 120 × 120-mm crystal. (auth)

5746 COMMUTATOR FOR A MOESSBAUER CONSTANT-VELOCITY SPECTROMETER. Lisichenko, V. I.; Petrichenko, N. N. (Inst. of Mechanics, Dnepropetrovsk, USSR) Instrum. Exp. Tech. (Engl. Transl.); 15: No. 5, 1456-1457(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 145(1972).

A simple commutator with stiff phasing of the instants at which the scaling channels are turned on and off with the instant at which the sign of the velocity changes is described; the commutator is designed using a circuit for dividing the number of pulses. (auth)

5747 ESTIMATION OF SEARCH SPECTRUM FOR GAMMA RAYS MEASUREMENT. Nishikawa, K. (Konan Univ., Kobe, Japan); Ishiketa, T.; Ueda, K. Mem. Konan Univ., Sci. Ser.; No. 14, 33-42(Nov 1971).

An attempt to determine the energy spectra of γ rays with a detector using organic scintillators and an electronic digital computer is reported. A cross correlation method was applied for signal detection, pattern recognition, system identification, etc. The cross correlation spectrum can be calculated when the search spectrum h(V) is obtained, where V is the pulse height in output of the detector system. The following three methods were used for estimation of the search spectrum: actual measurement of monochromatic gamma-rays, estimation by the Monte Carlo simulation, and estimation by analytical method using Klein-Nishina's formula. The estimation of the search spectra for detectors with inorganic scintillators or semiconductor detectors was also carried out. Data spectra for various γ-ray sources taken with the organic scintillation counter were accepted as the search spectra of the cross correlation method. Then, the cross correlation spectra were calculated. The relation between the energy of incident gamma rays and the peak positions of the cross correlation spectra is shown. From these results, it was found that application of the cross correlation method to the observed results with the organic scintillator was useful to determine the gamma energy spectra. (JA)

5748 PRIKLADNAYA YADERNAYA SPEKTROSKOPIYA. Vypusk 3. (Applied Nuclear Spectroscopy. Number 3). Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). 296p.

This volume contains 46 papers which were reported at the 21st Annual All-Union Conference on Nuclear Spectroscopy and the Structure of the Atomic Nucleus, within the sections "Applied Nuclear Spectroscopy" and "Techniques of Nuclear Spectroscopy". Basic characteristics of radiation sources, their application in the national economy, the development of semiconductor detectors of nuclear radiation, the design of new types of detectors, the use of modern spectrometric equipment in resolving practical problems, the stabilization of spectrometers, and the use of new methods for data handling and the analysis of results are discussed. The 46 titles are listed separately and indexed in this volume of NSA. (133 figures, 36 tables, 280 references) (KSW)

For titles of individual papers see: 5112–5124, 5235, 5633–5638, 5749–5757, 5791, 5792, 5809, 5831, 5832, 5871, 5884, 6499, 6540, 6673–6675, 6958, and 7195–7198.

5749 MATRIX METHOD FOR MEASUREMENT OF THE CONTENT OF RADIOISOTOPES IN AN ORGANISM AND THE INDIVIDUAL ORGANS OF MAN. Konstantinov, I. E.; Moiseev, I. D.; Fedorov, G. A.; Antonov, V. A. pp 83-85 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5750 ELECTRON SCATTERING BY SEMICONDUCTOR DETECTORS. Morozov, V. I.; Pelekhov, V. I. pp 91-97 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5751 SPATIAL CHARACTERISTICS OF A COLLIMATED SCINTILLATION GAMMA SPECTROMETER AS USED IN RADIATION SCANNING. Kostylev, V. A.; Fishman, L. Ya.; Narkevich, B. Ya.; Shmelev, S. E.; Vyachin, V. N. pp 98-103 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5752 SPECTROMETRY OF AEROSOLS BY A GAS COLLECTION METHOD. Stolyarova, E. L.; Volodin, S. N.; Frolov, S. G.; Gasnikov, N. K. pp 118-123 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5753 ANTICOINCIDENCE IN NUCLEAR SPECTROSCOPY AND ITS APPLICATIONS. Burmistrov, V. R. pp 170-180 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5754 INVESTIGATION OF SOME PROPERTIES OF NUCLEAR RADIATION DETECTORS MADE FROM CADMIUM TELLURIDE. Kalugina, L. I.; Pavlova, G. S.; Rodionov, Yu. F.; Mitin, V. I.; Kireev, P. S.; Vanyukov, A. V. pp 181-185 of Prikladnaya yadernaya spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5755 HIGH-RESOLUTION SEMICONDUCTOR BETA SPECTROMETER. Solov'ev, S. M.; Tyvin, L. I.; Eismont, V. P. pp 197-200 of Prikladnaya Yadernaya Spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5756 APPLICATION OF METHODS FOR CALCULATING THE EFFECTIVENESS AND MINIMIZING THE DIRECTED DIVERGENCE FOR THE PROCESSING OF γ SPECTRA. Doroshenko, G. G.; Zaitov, A. M.; Tarasko, M. Z. pp 233-242 of Prikladnaya Yadernaya Spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5757 CHOICE OF ALGORITHM IN PROCESSING OF SCINTILLATION γ SPECTRA BY DIGITAL COMPUTER. Smirnov, V. V.; Rimskii-Korsakov, A. A.; Chubarov, M. N. pp 243-245 of Prikladnaya Yadernaya Spektroskopiya. Vypusk 3. Latyshev, G. G. (ed.). Moscow; Atomizdat (1972). (In Russian).

5758 RESONANCES SUITABLE FOR THE CALIBRATION OF A TIME-OF-FLIGHT NEUTRON SPECTROMETER. Wynchak, S.; Rahn, F.; Carmada, H. S.; Hacken, G.; Slagowitz, M.; Liou, H. I.; Rainwater, J.; Havens, W. W. Jr. (Columbia Univ., New York). Nucl. Sci. Eng.; 51: No. 2, 119-123(Jun 1973).

Neutron resonance energies have been obtained for a number of selected well-isolated resonances in several elements and isotopes. The energy parameters were mainly obtained at Columbia University's 200-m time-of-flight spectrometer with high precision. These energy calibration points are important for a number of experiments in neutron and reactor physics. (auth)

5759 APPARATUS FOR THE SEPARATE DIGITAL REGISTRATION BY THE SIMULTANEOUS USE OF RADIONUCLIDES. Oeff, K.; Wenzel, M. German Patent 1,564,483. 1 Apr 1971. Filed date 5 Oct 1966. (In German).

An apparatus is described for the simultaneous separate registration of two or more radionuclides. It is characterized by the fact that it has two or more different channel pulse height analyzers which classify the impulses coming from the detector according to their height whereas the high-energy impulses are led directly to a device regardless of the registration and the low-energy impulses from the spectrometer are led to a second device whatever the registration after deduction of a variable percentage of impulses from the high-energy spectrometer. (TSS)

5760 IN SITU GAMMA SPECTROMETRIC MEASUREMENT OF NATURALLY OCCURRING RADIOACTIVE ELEMENTS AT $> 2\pi$ GEOMETRY. Grumbkov, A. P.; Semenov, G. S. Tr., Vses. Nauch.-Issled. Inst. Yadern. Geofiz. Geokhim.; No. 8, 302-306(1970). (In Russian).

Methods for background corrections for in situ gamma spectroscopy are discussed, and results using a NaI(Tl) spectrometer were found reproducible to within ±10%. (WHK)

5761 SIMPLE TWO-DIMENSIONAL ANALYZER OF BETA-GAMMA COINCIDENCES FOR ANALYZING SAMPLES OF RADIOACTIVE FALLOUT. Kovnatskii, E. F.; Roslyi, E. I.; Silant'ev, A. N. Tr., Inst. Eksp. Meteorol.; No. 25, 117-120 (1972). (In Russian).

A two-dimensional $\beta-\gamma$ coincidence analyzer based on two industrial AI-100 analyzers is described. A distinguishing feature of the unit is the possibility of registering the coincidence spectra on punched tape during measurement. The beta and gamma spectra taken in the single-crystal spectrometer mode are registered on the tape at the end of the experiment. A block diagram of the unit is given along with a schematic of the control module. (JPRS)

5762 CONTINUOUS GAMMA-RAY SPECTROSCOPY IN THE NATURAL ENVIRONMENT. Gold, R. (Joint Center for Graduate Study, Richland, WA); Strash, A. M.; Congel, F. J.; Roberts, J. H. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 48-53(Feb 1973).

Compton recoil gamma-ray spectroscopy is being developed for use in environmental monitoring. This method defines the most fundamental quantity in the specification of a gamma-radiation field, namely the absolute gamma-ray energy spectrum. In the environment, the method, therefore, allows a determination of the true gamma-ray flux to which human and other biological systems are subjected. Detectors of low atomic number are used because their response is based upon a single type of interaction (Compton) and such detectors present negligible perturbation to the gamma-radiation field being measured. The existence of only a single type of interaction within the detector greatly simplifies the unfolding of gamma-ray continua. Although the method is not intended to determine gamma-ray line spectra of trace radioisotopes in the environment, gamma-ray energy continua produced by this method do exhibit some of the fine structure associated with the presence of natural and man-made radioisotopes. Because the method is based upon actual measurements of energy deposition within the detector, a method of absolute dosimetry has evolved which properly accounts for the gamma-ray energy spectrum and does not require comparison with other detectors or the use of radiation standards of known intensity. (auth)

5763 ACTIVE SAMPLE ANTICOINCIDENCE GUARDED Ge(Li) SPECTROMETER FOR LOW LEVEL RADIONUCLIDE ANALYSIS. Markwell, F. R.; Bolch, W. E.; Roessler, C. E.; Ellis, W. H. (Univ. of Florida, Gainesville). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 54-56(Feb 1973).

The problem of spectral interference in large volume radioactive samples counted in a guarded Ge(Li) spectrometer is attacked by a new approach. By making the sample itself a liquid scintillator detector, and using coincidence and anticoincidence gating, the detrimental effects of self absorption can be eliminated. In addition, this technique (denoted gamma-beta coincidence and gamma-beta anticoincidence spectrum analysis) allows discrimination between modes of decay. The system design, logic, performance, and significance to low level radionuclide analysis is presented. (auth)

5764 EVALUATION OF A LARGE Ge(Li) DETECTOR FOR LOW-LEVEL RADIONUCLIDE ANALYSIS. Brauer, F. P.; Fager, J. E.; Mitzlaff, W. A. (Battelle Pacific Northwest Labs., Richland, WA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 57-64(Feb 1973).

An evaluation of a 26.3% relative efficiency Ge(Li) detector for low-level radionuclide analysis has been made. The detector performance for sources mounted at the detector end cap was compared with the other smaller Ge(Li) detectors and with an opposed Ge(Li) two detector system. Factors studied included resolution, peak-to-Compton ratios, background, detection efficiency at the end cap, source geometry, and relative sensitivity. The 26.3% relative efficiency detector was found to give superior end cap efficiencies, peak-to-Compton ratios, and relative sensitivities without sacrificing performance in the other factors studied. (auth)

5765 DEVELOPMENT AND APPLICATION OF A BETA–GAMMA–GAMMA MULTIDIMENSIONAL SPECTROMETER. Wogman, N. A.; Brodzinski, R. L. (Battelle Pacific Northwest Labs., Richland, WA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 73-79(Feb 1973).

A beta–gamma–gamma multidimensional spectrometer has been developed which employs two 12-inch diameter by 8-inch thick NaI(Tl) crystals with associated 4-inch thick NaI light pipes and two 5-inch diameter by $\frac{1}{2}$-inch thick gas proportional counters as principal detectors and which utilizes two 40-inch diameter by 24-inch thick plastic phosphors as anticoincidence shields. The detector system is coupled to two 4096 word computer memories which record gamma-ray events in coincidence with either beta detector. The gamma-ray energies identify the radionuclide while the beta detectors can identify the relative position of the radioactivity in the specimen being analyzed. The background and efficiency of the system and its application to the identification of radionuclides in environmental, biological, and extraterrestrial materials are discussed. (auth)

5766 APOLLO ALPHA SPECTROMETER. Jagoda, N.; Kubierschky, K.; Frank, R.; Carroll, J. (American Science and Engineering, Cambridge, MA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 90-98(Feb 1973).

Located in the Science Instrument Module of Apollo 15 and 16, the Alpha Particle Spectrometer was designed to detect and measure the energy of alpha particles emitted by the radon isotopes and their daughter products. The spectrometer sensor consisted of an array of totally depleted silicon surface barrier detectors. Biased amplifier and linear gate techniques were utilized to reduce resolution degradation, thereby permitting the use of a single 512 channel PHA. Sensor identification and in-flight radioactive calibration were incorporated to enhance data reduction. (auth)

5767 AUTOMATIC RADIOACTIVE INVENTORY SYSTEM. Zimmer, W. H. (Atlantic Richfield Hanford Co., Richland, WA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 352-360(Feb 1973).

The philosophy used in the Ge(Li) detector configuration design and small computer programming for an Automatic Radioactive Inventory System is presented. The range of application is nondestructive, low-density energy analysis from natural and fallout radiation in soils to high-level radiation in solid waste packages. (auth)

5768 GAMMA RAY EFFICIENCY COMPARISONS FOR Si(Li), Ge, CdTe, AND HgI_2 DETECTORS. Malm, H. L.; Raudorf, T. W.; Martini, M.; Zanio, K. R. (Atomic Energy of Canada Ltd., Chalk River, Ont.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 500-509(Feb 1973).

Gamma-ray efficiency measurements were made for Si(Li), Ge, CdTe and HgI_2 spectrometers and detectors of comparable sizes for gamma ray energies from 60 keV to 3.85 MeV. Full energy efficiency measurements of cooled Si(Li) and Ge spectrometers and a room temperature CdTe spectrometer show that the efficiencies improve in going from silicon ($Z = 14$) to germanium ($Z = 32$) to cadmium telluride ($Z = 50$) in agreement with the photoelectric cross-sections which vary as Z^5. Because of its shorter carrier drift lengths, the CdTe spectrometer must be operated at the highest practical voltages. The detection efficiencies, based on all pulses above a threshold set by noise, were measured for Si(Li), CdTe and HgI_2 detectors at room temperature. A 30 keV threshold and small photoelectric cross-section combine to give an efficiency minimum for the Si(Li) detector for $100 \text{ keV} < E_\gamma < 200 \text{ keV}$. Both CdTe and HgI_2 detectors have no such minimum. In addition the higher electronic stopping powers of HgI_2 and CdTe in comparison with Si reduce edge effects—an important factor in high energy γ-ray efficiency. (auth)

5769 CdTe GAMMA SPECTROMETERS FOR NONDESTRUCTIVE ANALYSIS OF NUCLEAR FUELS. Higinbotham, W. (Brookhaven National Labs., Upton, NY); Zanio, K.; Akutagawa, W. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 510-513(Feb 1973).

Gamma-ray spectrometry is widely used for identification and assay of nuclear fuel and scrap materials. CdTe detectors are especially promising for use by nuclear safeguards inspectors because of their small physical size and good energy resolution. A 20 mm^3 CdTe detector has been used to determine the isotopic composition of uranium and plutonium samples. The energy resolution is superior to that of NaI so that the major lines of ^{239}Pu are more easily distinguished from interfering lines of ^{241}Pu and ^{241}Am. (auth)

5770 OPERATIONAL CHARACTERISTICS OF A HIGH PURITY GERMANIUM PHOTON SPECTROMETER COOLED BY A CLOSED-CYCLE CRYOGENIC REFRIGERATOR. Marler, J. M.; Gelezunas, V. L. (General Electric Co., Philadelphia). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 522-527(Feb 1973).

Experience with several (commercially available) miniature closed-cycle refrigerators used to cool a high purity germanium photon detector is reported. While maintaining good resolution, closed-cycle cooling has resulted in a versatile photon spectrometer with long storage times, variable length run times, and freedom from the need for a liquid nitrogen supply. The demonstrated resolution and background levels indicate the concept to be especially useful for field measurements in problems of general radioisotope detection and in some applications of on-line x-ray fluorescence. (auth)

5771 COINCIDENCE SPECTROSCOPY OF FISSION FRAGMENTS VIA MICA TRACK DETECTORS. Kiely, F. M.; Pate, B. D. (Simon Fraser Univ., Burnaby, BC). Nucl. Instrum. Methods; 109: No. 2, 355-363(1973).

The utility of mica track detectors in a sandwich configuration has been investigated in measurements of mass and angular distributions of fission fragments from ^{235}U + thermal neutrons, ^{238}U + 14-MeV neutrons, and ^{197}Au + 80-MeV alpha particles. It is concluded that, while angular distributions are poorly reproduced (due to problems with tracks at small angles to the mica surface and to the observation direction), fragment mass distributions may be inferred with useful accuracy. (auth)

5772 FISSION FRAGMENT ENERGY SPECTRUM DETERMINATION WITH SOLID STATE NUCLEAR TRACK DETECTORS. Khan, H. A.; Durrani, S. A. (Univ. of Birmingham, Eng.). Nucl. Instrum. Methods; 109: No. 2, 341-347(1973).

Attempts are described to optimize the spectrometric response of a number of solid state nuclear track detectors (SSNTD), including fused silica, soda-lime glass, and phosphate glass. Diameters of the etch pits resulting from normally incident beams of fission fragments from a ^{252}Cf source in vacuum have been measured, by both optical and scanning-electron microscopy, as functions of the period of etching and of the thickness of Al absorber introduced in the path of the beam. The best resolution of the heavy and light fission fragment groups, as inferred from the diameter distributions, is obtained with phosphate glass SSNTD covered with ≈ 5 μm Al foil during irradiation. (auth)

5773 PORTABLE X-RAY FLUORESCENCE SINGLE ELEMENT ANALYZER. McCrary, J. H.; Edmonds, C. M. Nucl. Instrum. Methods; 109: No. 2, 389-391(1973).

A portable, battery powered x-ray fluorescence analyzer sensitive to a given element within an unknown sample, has been fabricated and tested. The device utilizes an x-ray tube source, balanced filters, dual NaI(Tl) counters, and the electronics necessary to provide instant readout of the presence and abundance of the element in question. The system is housed in a single package which occupies a volume of 7 l and which weighs 5.5 kg complete with rechargeable batteries and carrying case. The analyzer described here is sensitive to the presence of 100 μg/cm^2 of copper. By changing the filters, it can be made sensitive to other elements with $Z > 20$. (auth)

5774 BACKGROUND CORRECTIONS FOR QUANTITATIVE ELECTRON MICROPROBE ANALYSIS USING A LITHIUM DRIFTED SILICON X-RAY DETECTOR. Ware, N. G.; Reed, S. J. B. (Australian National Univ., Canberra). J. Phys., E (London); 6: No. 3, 286-288(Mar 1973).

The rather broad peaks obtained with a Si(Li) detector often necessitate extrapolation of background over a considerable energy range. In many samples no background readings free of interference from peaks can be obtained below 2.7 keV. A procedure for calculating background over the whole spectrum from measurements at 2.96 keV (Ar Kα) and 9.87 keV (Ge Kα) is described. For samples consisting of elements below 30 in atomic number the background correction can be determined with an error not exceeding an equivalent concentration of 0.1 wt%. (auth)

5775 NEW TECHNIQUE FOR HIGH-RESOLUTION CHARGED-PARTICLE MASS IDENTIFICATION. Hoffmann, G. W.; Pipitone, F.; White, J. R. (Univ. of Texas, Austin). Nucl. Instrum. Methods; 109: No. 2, 399-400(1973).

A simple technique is described which exploits an electrostatic particle guide to transport charged particles and permit time-of-flight measurements over quite long flight paths. Where excellent mass resolution, together with the best energy resolution from charged particle detectors is desired this single-detector energy-mass identifier is far superior to conventional particle telescope systems. (auth)

5776 MEASURING THE RECOIL RANGE OF ALPHA EMITTING NUCLIDES PRODUCED BY NUCLEAR REACTIONS BASED ON THE SHIFTING OF THE ENERGY SPECTRA. Application to Transfer Reactions of Heavy Ions. Bimbot, R.; Gardes, D. (Laboratoire de Chimie Nucleaire, Orsay, France). Nucl. Instrum. Methods; 109: No. 2, 333-340(1973). (In French).

The purpose of this method is to measure the recoil range of alpha decaying nuclides produced through nuclear reactions. The penetration distance of the α-emitter is revealed by the energy loss of the α-particle before leaving a thick catcher foil. The comparison of the α-spectrum from the catcher foil with the α-line from a thin sample of the same nuclide is used to determine the energy shift ΔE that can be converted into range units after suitable calibration. The width of the α-peak is connected with the experimental broadening and used to calculate the straggling parameter ρ. The method can be used to measure the ranges of heavy nuclei with kinetic energy varying from 70 keV to 20 MeV; it avoids tedious handling of thin catcher foils. As far as the resolution is concerned the method is better than the stacked foils technique for range values smaller than 0.2 mg/cm^2. The method is particularly suitable to transfer reaction studies especially for recoil range measurement at each emission angle in the laboratory system. (auth)

5777 TRANSMISSION AND SHIFTS IN TIME-OF-FLIGHT SPECTROMETRY OF LOW ENERGY IONS USING AN ELECTROSTATIC PARTICLE GUIDE. Igersheim, R.; Abbe, J. C.; Paulus, J. M.; Amiel, S. (Univ., Strasbourg). Nucl. Instrum. Methods; 109: No. 2, 301-304(1973).

Previous measurements performed to test the use of an electrostatic particle guide for time-of-flight spectroscopy of low energy ions have further been investigated. The transmission of a guide as a function of the entrance angle of the ions into the tube and the distance of the beam from the tube axis have been measured. This technique has been applied to the spectroscopy of recoils from an α-source. The results show that the transmission and the time-of-flight depend markedly on the charge state of the recoiling ions. (auth)

5778 NEUTRON SPECTRUM MEASUREMENT WITH FISSILE DETECTORS. Nimis, M.; Sangiust, V.; Terrani, M.; Terrani, S. (Politecnico, Milan). Nucl. Instrum. Methods; 109: No. 2, 285-288(1973).

A set of fissile nuclides has been used for the determination of the epicadmium spectrum at the center of the core of the L54 reactor. The reaction rates were determined by delayed neutron counting. The usefulness of this particular choice of detectors and counting technique is discussed. (auth)

5779 DEVELOPMENT AND APPLICATION OF A BETA–GAMMA–GAMMA MULTIDIMENSIONAL SPECTROMETER. Wogman, N. A.; Brodzinski, R. L. (Battelle Pacific Northwest Labs., Richland, WA). Nucl. Instrum. Methods; 109: No. 2, 277-283(1973).

A beta–gamma–gamma multidimensional spectrometer has been developed which employs two 12″ diameter by 8″ thick NaI(Tl) crystals with associated 4″ thick NaI light pipes and two 5″ diameter by ½″ thick gas proportional counters as principal detectors. The system utilizes two 40″ diameter by 24″ thick plastic phosphors as active anticoincidence shields in addition to four inches of borated paraffin and four inches of lead as passive shields. The detector system is coupled by two 4096 word computer memories which record gamma-ray events in coincidence with either beta detector. The gamma-ray energies identify the radionuclide while the beta detectors identify the relative position of the radioactivity in the specimen being analyzed. The background and efficiency of the system and its application to the identification of radionuclides in environmental, biological and extraterrestrial materials are discussed. (auth)

High Energy Physics Instrumentation

Refer also to abstracts 6520, 6521, 6530, and 6534.

5780 (CERN/ECFA–72/4(Vol.1), pp 117-144) NEW FACILITIES IN VISUAL DEVICES. Jul 1972.

In ECFA: 300 GeV Working Group.

Topics include rapid cycling bubble chambers, the use of a streamer chamber in high-energy physics, isotropic streamer chamber development, and vidicon readout systems for streamer chambers and rapid cycling bubble chambers. (WHK)

5781 (CERN/ECFA–72/4(Vol.1), pp 351-389) PARTICLE IDENTIFICATION. Jul 1972. (In English and French).

In ECFA: 300 GeV Working Group.

Topics include a proposed deuterium transition radiation detector for use in experiments above 70 GeV, a combined transition radiation-relativistic rise detector proposed for the 300 GeV, multilayer relativistic rise detector proposal, drift chambers with high space and time resolution, a graphical comparison of Cherenkov counters for particle identification at high energies, recoil semiconductor detector telescopes, and considerations on a recoil spectrometer for experiments at the 300 GeV SPS. (WHK)

5782 (JINR-P8-7025) NEW METHOD OF SHIELDING THE CRYOGENIC SURFACES FROM CONTAMINATION BY HARDENED GASES AND ITS APPLICATION AT HYDROGEN BUBBLE CHAMBER WITH DEWAR HEAT INSULATION SYSTEM. D'yachkov, E. I.; Zel'dovich, A. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A new method of shielding the cryogenic surfaces surrounded by noncondensed gas from contamination by hardened gases is suggested. The essence of the method consists in that in the space around the shielded surface, a flux of pure noncondensed gas is formed and directed toward the diffusing impurities. By the example of the JINR hydrogen chamber, the efficiency of this method is compared with previous ones. (auth)

5783 (ORNL-TM–4118) ENERGY DEPOSITION AND ENERGY DEPOSITION FLUCTUATIONS IN AN IONIZATION SPECTROMETER AND A TOTAL-ABSORPTION NUCLEAR-CASCADE COUNTER. Gabriel, T. A.; Chandler, K. C. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 30p. Dep. NTIS $3.50.

Calculations have been carried out to determine the energy deposition and energy-deposition fluctuations produced by incident 28-GeV/c protons on an ionization spectrometer. In obtaining the pulse-height characteristics of the spectrometer, the nonlinearity of the light pulses is taken into account by the use of Birks' law and is shown to be of importance. A discussion of the experimental difficulties encountered in locating the position of the initial proton interaction within the spectrometer is also presented. Similar calculated results on the energy deposition and energy-deposition fluctuations are presented for 8-GeV/c negative pions incident on an NaI(Tl) total-absorption nuclear-cascade (TANC) counter. Also included for 8-GeV/c incident negative pions is the laterally integrated energy deposition as a function of depth in a tin absorber. In general, the calculational approach used is shown to yield good agreement with the experimental data. (auth)

5784 (RHEL/R-262) SURVEY OF POSITION SENSITIVE DETECTORS AND MULTI-COUNTER ARRAYS WITH PARTICULAR REFERENCE TO THERMAL NEUTRON SCATTERING. Meardon, B. H.; Salter, D. C. (Rutherford High Energy Lab., Chilton (England)). Nov 1972. 83p. Dep. NTIS (U.S. Sales Only) $6.25. UK 80 pence.

Position sensitive detectors have not, so far, been used for thermal neutron studies in the United Kingdom. A survey of position sensitive detection systems and multi-counter arrays is presented, with the aim of indicating their potential for use and development in this field. Fundamental aspects of thermal neutron detection and scattering are discussed. Particular detection systems are considered for the many branches of study and recommendations are made. (auth)

5785 (SLAC-Trans-137) EFFECT OF A MAGNETIC FIELD ON THE EFFICIENCY OF A SPARK CHAMBER. Nekrasov, K. G. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1971. Translation of JINR-P13-5811. 11p. Dep. NTIS $3.00.

A more precise value has been obtained for the criterion of spark-over in neon, on the basis of the shower-streamer theory of discharge. It is shown that the minimum resolution time of a spark chamber depends on the dimensions of the zone necessary for discharge development. The influence of a magnetic field on the parameters determining spark-chamber efficiency is considered. (auth)

5786 USE OF AN LI-604 DISSECTOR IN DEVICES FOR PROCESSING NUCLEAR INTERACTIONS IN BUBBLE CHAMBERS. Ovsov, Yu. V.; Noskov, Yu. G.; Khalikova, G. M. (Inst. of High-Energy Physics, Alma-Ata, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 1033-1035(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 58-60(1972).

The requirements imposed on a transmitting television tube when it is used in devices for processing photographs in bubble chambers are considered. The use of tubes of the dissector type instead of vidicons in television automata for processing photographs of nuclear interactions in a bubble chamber increases the productivity of the devices by a factor of 4 to 5, improves the reliability of the equipment, and betters their operating characteristics. The use of a dissector allows complete automation of the measurement process and permits transfer of its supervision to a computer. (auth)

5787 EXPERIMENTAL INVESTIGATION OF MULTIPLE NEUTRON DISTRIBUTIONS IN COSMIC RAY NEUTRON MONITORS. Fujii, Z.; Kodama, M. (Inst. of Physical and Chemical Research, Wako, Japan). Rikagaku Kenkyusho Hokoku; 48: No. 4, 95-108(Jul 1972). (In Japanese).

In order to investigate experimentally some fundamental characteristics of multiple neutrons produced in the cosmic ray neutron monitor, 11 sets of neutron monitors of different geometries each consisting of 22 IGY-type neutron counters were prepared on Mt. Norikura and a relation between the multiplicity spectrum and the monitor geometry was obtained. Coincidence rates with frequencies for an air shower of small size ($\sim N^4$) showed less contribution of multiple events produced in the atmosphere relatively to those in the monitor, being less than 1%. Also a similar conclusion was deduced from measurements of the decoherence character of multiple events using two sets of same type monitors. (auth)

5788 FILMLESS TELEVISION METHOD FOR RECORDING THE TRACKS OF NUCLEAR PARTICLES IN SPARK CHAMBERS (REVIEW). Petrakov, A. V.; Klevalin, V. A.; Gorokhov, V. P. (All Union Correspondence Electrical Engineering Inst. of Communication, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 973-982(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 7-16(1972).

The advantages of the television method of recording the tracks of nuclear particles detected by spark chambers are considered; the causes limiting the performance of the television equipment are analyzed, and the prospects of the television method are indicated. (55 references) (auth)

5789 AUTOMATIC ACQUISITION OF INFORMATION FROM STREAMER CHAMBERS BY A SUPERORTHICON. Asatiani, T. L.; Gorokhov, V. P.; Ivanov, V. A.; Petrakov, A. V. (All Union Correspondence Electrical Engineering Communications Inst., Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 1039-1041(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 64-65(1972).

The possibility of recording streamer tracks by means of an LI-17 superorthicon using a batch-produced PTU-101 industrial installation is considered. The investigations showed that superorthicons may be used successfully for automatic acquisition of information from streamer chambers. (auth)

5790 MAGNOLIA DETECTOR (22 JUL 1972) (ENGINEERING MATERIALS). (Cambridge Electron Accelerator, Mass.). (CAPE-2329).

147 drawings.

5791 THEORY OF SHOWER SPECTROMETERS. Stolyarova, E. L.; Samedov, V. V.; Novikov, E. S. pp 186-196 of Prikladnaya Yadernaya Spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5792 SPECTROMETRIC DEVICE WITH SPARK CHAMBERS FOR INVESTIGATING MECHANISMS OF HIGH-ENERGY NUCLEAR REACTIONS. Burgov, N. A.; Vlasov, M. K.; Kiselev, Yu. T.; Man'ko, A. V.; Panov, A. A.; Terekhov, Yu. V.; Chumakov, M. M.; Ushakov, V. I. pp 216-220 of Prikladnaya Yadernaya Spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5793 DEVELOPMENT OF SPARK CHAMBERS FOR USE IN MEASUREMENTS OF THE CHARGE SPECTRUM OF HIGH ENERGY COSMIC RAYS. Arens, J. F. (Goddard Space Flight Center, Greenbelt, MD); Cooper, G. F.; Greer, C. R.; Jellison, J.; Macnee, A. B.; Ormes, J. F.; Ryan, M. J.; Seidenberg, B.; Baffo, S. P.; Chase, R.; Crannell, C. J.; Powell, F. X. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 125-134(Feb 1973).

The High-Energy Cosmic Ray Experiment, flown on balloons by a group at Goddard Space Flight Center, is designed to measure the charge, the energy, and the arrival direction of high-energy cosmic rays. A wire-grid spark chamber is employed to determine the trajectory of each incident primary particle which satisfies the experiment trigger criteria. Optimum trajectory-determination efficiency depends on parameters, the values of which vary with the charge of the incident particle. The functional dependence on the voltage applied to the wire grids and on the delay in application of the high voltage trigger for several different values of the DC clearing field was measured for fully ionized nitrogen nuclei and for singly charged particles. The voltage was found to be the most suitable parameter to vary in order to maximize the spark formation efficiencies and to minimize spurious spark formation. Because of the low fluxes of high-Z, high-energy cosmic rays, long experiment exposure times such as those obtained in satellites are desirable. To adapt the spark chambers for use with experiments with a duration of more than one year and total accumulated events in excess of 3×10^8, the useful life times of both the high-voltage triggering circuit and the spark-chamber gas needed to be improved. Krytron high-voltage triggering devices have been developed which will perform satisfactorily for more than 3×10^8 simulated events at a rate of 10 events/sec, an improvement of approximately a factor of 10. SCR high-voltage triggering circuits have been developed which satisfy both the lifetime and the total event criteria. Modifications of the SCR circuits enable varying the spark chamber trigger voltage as a function of the charge signature of the incident cosmic ray primary. The problem of chemical contamination of the spark chamber has also been ameliorated. (auth)

5794 HIGH SPATIAL RESOLUTION WIRE SPARK CHAMBER SYSTEM USING ELECTROMAGNETIC DELAY LINE READOUT. Kuehne, F. J.; Swanson, F. R.; Favale, A. J. (Grumman Aerospace Corp., Bethpage, NY). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 135-139(Feb 1973).

A high spatial resolution multiwire spark chamber system designed to measure the position of charged cosmic particles as they are deflected in a high magnetic field has been developed, to study its application for space experiments. The system which enables determination of the particle's momentum and arrival direction, is part of an over-all program to design and test cosmic ray detection experiments for use on satellites. The need for more accurate, compact, simpler, and cheaper readout devices motivated the study. The system employs electromagnetic delay lines inductively coupled to the wires of specially designed spark chambers. The device has spatial resolution capability better than 140 μm (one sigma), is low in cost and weight, highly reliable, and is capable of operating in a high magnetic field. (auth)

5795 SURVEY OF PROPORTIONAL WIRE CHAMBER ELECTRONICS AND READOUT SYSTEMS. Dhawan, S. (Yale

Univ., New Haven). AT(11-1)3075. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 166-171(Feb 1973). (YALE-3075-616).

A survey of the currently used electronics with multiwire proportional chambers is examined for the high energy physics applications. (auth)

5796 DESIGN, CONSTRUCTION, AND OPERATIONAL CHARACTERISTICS OF A PROPORTIONAL BEAM HODOSCOPE SYSTEM. Davier, M.; Friday, R. G.; Mauro, K.; McShurley, D. (Stanford Univ., CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 190-192(Feb 1973).

A high-resolution beam hodoscope system consisting of 4 proportional wire chamber planes of 1 mm wire spacing is described. This system is currently in use in a secondary beam at SLAC in conjunction with a wire spark-chamber spectrometer; its main purpose is to measure the position of beam particles before they strike a liquid hydrogen target. In order to match the resolution of the spectrometer and allow the accurate finding of a vertex between incident and scattered tracks, the spatial resolution of the hodoscope had to be 0.5 mm or better. Therefore the wire spacing was chosen to be 1 mm, a rather unconventionally small value. Another important consideration lies in the fact that the beam operates at a high rate of up to 10 MHz and consequently very good time resolution must be achieved in order to limit accidental counts. The described system has been operated successfully for a period of about 10 weeks of running and is currently being modified to improve its performance. (auth)

5797 DIGITALLY CONTROLLED FAST LOGIC MODULES. Horvath, P. (Joint Inst. for Nuclear Research, Dubna, USSR). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 193-198(Feb 1973).

Fast logic circuits with the repetition rate of 200 MHz and the time resolution of 10^{-9} s have been digitized using the CAMAC interface. Some results of a project of the fast coincidence system connected to the CAMAC autonomous control system are presented. In the system the operating mode of the coincidence unit and the inherent delay of the logic channels can be set automatically and the stability of the system can be controlled during the experiment. The Digital Coincidence Unit and the Digital Delay are described. The fast coincidence system presented is intended for particle beam identification and triggering of the set of counter hodoscopes in high energy physics experiments. (auth)

5798 CAMAC MAGNETOSTRICTIVE READOUT SYSTEM USING SCHOTTKY MEMORIES. Bertolucci, B. (Stanford Univ., CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 361-366(Feb 1973).

A magnetostrictive readout modular system using fast TTL memories to be used with the spark chamber in the magnetic detector of SPEAR is described. The main characteristics of this system are its expandability, its simple logic configuration, its high recording speed and its capacity of 15 sparks/wand with a word length of 16 bits per spark. (auth)

5799 DIGITIZING ELECTRONICS FOR THE EMI MULTI-WIRE PROPORTIONAL CHAMBERS. Binnall, E.; Kirsten, F.; Lee, K.; Nunnally, C. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 367-374(Feb 1973).

A complete system of electronics for digitizing pulses from a large array of multi-wire proportional counters is described. The system is based on the method of coupling the chamber pulses onto delay lines developed by Perez-Mendez. All three wire planes of each chamber are digitized, giving positional information for each avalanche in the chamber on three coordinates, x, y and a redundant coordinate. The system will be used with an array of 30 chambers each one meter square, which will serve as an External Muon Identifier (EMI) for the 15-foot diameter bubble chamber in the neutrino beam line at NAL. Up to 16 events can be digitized in a 60 μs beam spill. (auth)

5800 ENERGY CALIBRATION OF A COSMIC RAY IONIZATION SPECTROMETER. Whiteside, H. (Federal City Coll., Washington, DC); Crannell, C. J.; Crannell, H.; Ormes, J. F.; Ryan, M. J.; Jones, W. V. Nucl. Instrum. Methods; 109: No. 2, 375-387(1973).

The NASA/GSFC High Energy Cosmic Ray Experiment was calibrated at the AGS at Brookhaven National Laboratory during the summer of 1970 using protons and pions with energies from 9.3 GeV to 17.6 GeV. The best measure found for the energy E of an incoming primary particle is ΣI, the total number of ionizing particles observed in the instrument, summed over the various iron modules. The resolution in the calibration energy range is about ±30% (s.d.) over a wide range of incident angles and positions. The calibration function may be parameterized as $E = \Sigma I/K$, where K is predominantly a function of the location of the first interaction and the trajectory of the incoming particle. To a fair approximation the geometrical dependence of K can be encompassed by writing K as a function of d, the distance from the first interaction along the primary ray to the edge of the instrument. Empirically, $K = 5.83\ [1-\exp(-d/\lambda)]\cos\theta$, where λ is a characteristic length which is a slowly varying function of energy. The value of K, and thus the average energy values calculated from the experimental data are accurate to about ±10% under calibration conditions. (auth)

5801 MEASURING BUBBLE CHAMBER TRACKS. Frisch, O. R. (Cambridge Univ., Eng.). Phys. Bull. (London); 24: 275-277(May 1973).

From machine perception of patterns and pictures; Teddington, Eng. (Apr 1972).

The analysis of the many millions of photographs produced annually of fast particle tracks in bubble chambers is a mammoth task. A wide range of machines has been developed to automate the process. Track following machines have been developed which use a simple form of machine perception to pick out the tracks on the photographs, this information then being transmitted to a computer for analysis. Track following machines generally employ a fine light beam to probe the film for tracks with a photomultiplier to pick up the transmitted light. In the PEPR and POLLY systems, line images with variable directions are generated on a cathode ray screen and projected on the film. In Sweepnik the system uses a laser as a light source. The line image carries out a circular scan and any track passing close enough to the center of the scan is recognized in a single scan. Details of the servo mechanism which moves the scan center over the film are given. The software, in which lies the "intelligence" of the machine, is described. (UK)

5802 SCALED MWPC 0.5 MM WIRE SPACING. Souder, P. A.; Sandweiss, J.; Disco, A. A. (Yale Univ., New Haven). Nucl. Instrum. Methods; 109: No. 2, 237-240(1973).

A multiwire proportional chamber may be scaled down to improve its spatial resolution provided that every relevant distance is scaled. A chamber with excellent operating characteristics with wires 0.5 mm apart is described. The wires are 5 μm in diameter and the chamber operates at a pressure of four atmospheres with a mixture of 80% argon and 20% CO_2. (auth)

Radiometric Instruments

Refer also to abstract 5885.

5803 (AERE-PR/NP-18, pp 67/83) INDUSTRIAL PHYSICS AND RADIOISOTOPE RESEARCH. Mar 1972.

5804 (ANCR-1105) TELEMETERED PROFILING ISOTOPIC SNOW GAUGE: FINAL REPORT AND SPECIFICATIONS. Randolph, P. D.; Coates, R. A.; Killian, E. W. (Aerojet Nuclear Co., Idaho Falls, Idaho). Apr 1973. Contract AT(10-1)-1375. 327p. Dep. NTIS $7.60.

An engineered telemetered snow gauge is described. The gauge can be used to measure snow depth, snow density at one-half inch depth intervals through a snow pack, total water content, changes in water content, amount of new snow since last measurement, rainfall amount, and snow melt-rate between measurements. It operates by measuring the attenuation by snow of gamma rays traveling a fixed distance between two vertical tubes. Four such gauges are operated as a telemetered network from a central base station in Idaho. The base station uses a small data processor for gauge control and data analysis. The field units are in Alaska, Oregon, Idaho, and Colorado. The gauge principle, its operation, and a discussion of each of the existing gauges are presented. Performance requirements are given for gauge parts as well as complete mechanical and electronic drawings. A base station user's manual, a software description and a complete software listing are also included. (auth)

5805 NONDESTRUCTIVE TESTING OF THE WEIGHT PER UNIT AREA OF KNITWEAR. Buehler, G. (Institute fuer Textilund Faserforschung Stuttgart, Ruetlingen, Ger.). Melliand Textilber. Int.; 53: No. 11, 1236-1244(1972). (In German).

The use of radiometric methods in the textile industry for the continuous, nondestructive measurement of the weight per unit area of knitwear is discussed. Studies on whether and to what extent the efficiency and accuracy of a ^{85}Kr device will be influenced by various parameters such as the textile material itself, the structure of the knitwear, the humidity content of the material, the climatic conditions at the place of fabrication, and the elasticity and degree of stretching of the material were made. The industrial application of the method was investigated in order to determine the advantages and disadvantages of one central measuring unit (irradiation technique), and single measuring units (backscattering). Both possibilities were tested in practice. The central measuring unit was tested with a shrinking device and the single measuring unit with a circular knitting machine. The results of the tests showed that even though both possibilities seem to be equally well suited as far as the method is concerned, the central measuring unit seems more favorable for practical reasons. (GE)

5806 RADIOMETRIC CONTROL METHODS IN THE TEXTILE INDUSTRY. 2. Wegener, W. (Technische Hochschule, Aachen). Melliand Textilber. Int.; 53: No. 10, 1161-1166(1972). (In German).

A survey is given of currently applied continuous radiometric methods for the purpose of (1) humidity measurement and control of uniformity in drying and wetting processes, (2) controlling the uniformity of layers of impregnating agents and dyestuffs and other coatings, (3) controlling and measuring the wear of textile fabrics, and (4) controlling the level height and density of container contents. Scientific aspects of these methods are discussed. (GE)

5807 NUCLEAR WIRE GAGING. II. Neumann, J. Wire; 22: No. 120, 160-164(Aug 1972).

A description of the Knüfelmann system is given. This is claimed to be the only fully automatic system that has proved to be suitable for wire production processes. It is applicable to all materials and wire cross-sections, requiring only a slight modification of the physical measuring system and mechanical design details to accommodate such variations. The dynamic calibration takes into account the conditions which occur in production. (Metals Abstr.)

5808 NUCLEAR WIRE GAGING. Plesch, R. Wire; 22: No. 119, 109-115(Jun 1972).

Nuclear measurement is independent of the material of the wire; it is without physical contact; and it permits the use of digital measuring technology, since the data delivered by the radiation detector occur in the form of electric pulses. The digital system is preferred to the analogue system, especially under rough, continuous service-conditions, and it is far less subject to faults or external influences. Sensitivity and accuracy are reported. (Metals Abstr.)

5809 USE OF MONOENERGETIC ELECTRONS FOR THICKNESS MEASUREMENT OF SINGLE-LAYER COATINGS. Gruzin, P. L.; Rodin, A. M.; Skachkov, E. V. pp 148-155 of Prikladnaya Yadernaya Spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5810 GAMMA-RAY ATTENUATION USED FOR MEASURING THE MOISTURE CONTENT AND HOMOGENEITY OF POROUS CONCRETE. Nielsen, A. F. (Technical Univ., Lyngby, Denmark). Bldg. Sci.; 7: No. 4, 257-263(Dec 1972).

The method of gamma-ray-attenuation for the determination of moisture content has the advantage of being nondestructive and independent of temperature gradients in the material. It is also possible to check the homogeneity of specimens by this method. The Laboratory of Thermal Insulation has equipment with a 100 mCi ^{241}Am source for measurements on porous concrete. A survey of the theory for gamma-ray-attenuation and the calibration of the equipment including measured values found for this equipment are given. Some examples are given of measurements of homogeneity and moisture content for different specimens. (auth)

5811 IMPROVEMENTS IN GAUGES. Grogan, A. F.; Grabin, R. G. (to Associated Engineering Ltd.). British Patent 1,308,135. 28 Feb 1973. Filed date 17 Jun 1969. 13p.

Reference is made to thickness gauges for measuring the wall thickness of a hollow body, such as a turbine blade. The gauge described comprises a radioactive source with a detector positioned opposite the source. Means are provided for supporting the hollow body to be gauged so that the source can enter the bore of the body and be maintained central in the bore during the measuring operation; means are also provided so that the source can effectively travel along the bore. Preferably the source and detector are fixed and the hollow body is mounted so as to traverse them. The relative movement may either be continuous or in steps. Means may also be provided for rotating the hollow body in order to measure its wall thickness at different positions along its axis. The detector preferably comprises a scintillation counter, with photomultiplier and ratemeter feeding a recording device. (UK)

5812 EVALUATION OF CdTe FOR NUCLEONIC FUEL GAUGING. Bupp, F. (TRW Systems Group, Redondo Beach, CA); Nagel, M.; Akutagawa, W.; Zanio, K. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 514-521 (Feb 1973).

A nucleonic system using an array of source-detector pairs to gage propellant tanks of up to approximately 20,000 lb under zero g conditions was analyzed. The sources of error in determining the propellant mass were outlined and ways of reducing the sampling error were considered. Detector characteristics, the source strength and photon energy, and the consequential radiation dose and source collimator mass are specified. To test the feasibility of a multi source-detector pair nucleonic gaging system six 200 mm^3 CdTe detectors were positioned opposite six collimated ^{137}Cs sources on an eight foot diameter spherical tank containing up to 19,000 lb of slat water as a fuel simulant. An accuracy of approximately 0.6% of full tank loading was obtained under 1 g conditions. Propellant loading was determined by counting photoevents above a fixed energy threshold. A separate analysis of the detectors showed that counting efficiencies ranged from 66% to 83% of the theoretical values due to tailing of the photopeak. Due to trapping and detrapping, count rates increased nearly linearly with increasing temperature from -40°C to 65°C with the value 0.35%/°C. Count rates also increased with increasing bias, with values as low as 0.025%/volt. These studies indicate the feasibility of using a highly collimated system of source detector pairs to gage propellants under zero g conditions. (auth)

5813 ON-LINE COMPUTER FOR THE CONTROL OF THE MASS PER UNIT AREA OF EXTRUDED AND ROLLED FOILS. Kowalski, W. (Landis und Gyr AG, Zug, Switzerland). Gummi, Asbest, Kunstst.; 25: No. 8, 744-752(1972). (In German).

Besides a more or less linked complex control system for the control of individual thermal, mechanical and technical drive parameters, extruders and calenders need a super control system to monitor the final mass per unit area of the product and correct any deviations from the ideal value. This guarantees consistent measurements of the end product, independent of the unavoidable changes in the raw material. The increasingly complicated transition from the one conventional analogue control system to the digital system with a process computer is shown. The uniqueness and advantages of the computer control are briefly discussed and a new type of measuring and control system for foils and similar shaped goods with integrated small computers is described for nuclear measurement methods by absorption of backscattering of β and weak γ rays. (GE)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstracts 6398 and 6417.

5814 (BMBW-FB-W-71-53) MAGNETIC COMPONENTS OF ELECTRONIC SYSTEMS FOR SPACE CRAFTS. Pt. 3. Henninger, P. (Siemens A. G., Munich (West Germany)). Nov 1971. 79p. (In German). INIS.

Under centrifugal accelerations of up to 2,000 g, the magnetic properties of soft-ferrite ring cores remain practically constant. Under static pressure loadings of up to 360 kp/cm^2, however, losses rise appreciably. The properties of oxide permanent magnets remain unaffected at pressures of up to 600 kp/cm^2. Irradiation of high-permeability ferrite cores with neutrons and protons leads to a degradation of both permeability and loss value with an increase in disaccommodation. Irradiation with γ rays produces only minor changes. Ferrites with low sensitivity to environmental conditions and an optimum combination of loss and stability characteristics are obtained by sintering ferrites until they are as free from pores as possible. Air gap, core shape, and calibration curve have been calculated for small pot cores of various shapes offering the advantage of rotary tuning. First samples with a semi-circular hole in the core have a tuning range of ±8% with sufficient precision of adjustment. (INIS)

5815 (CONF-730327-1) ELECTROMAGNETIC PULSE AND THE ELECTRIC POWER SYSTEM. Baird, J. K. (Oak Ridge National Lab., Tenn.). [nd]. 4p. Dep. NTIS $3.00.

From Annual meeting of the South Central Systems of NAPSIC; Jackson, Mississippi, USA (16 Mar 1973).

The electromagnetic pulse which accompanies the atmospheric explosion of a nuclear weapon and its effects on electronic equipment are briefly reviewed. Countermeasures for reducing the effects are listed. (TFD)

5816 (CONF-730416-1) EFFECT OF POLAR GROUPS ON THE POST-IRRADIATION CONDUCTIVITY OF POLYSTYRENE. Parkinson, W. W.; Kelly, M. J.; Salyer, I. O. (Oak Ridge National Lab., Tenn.). 1973. 31p. Dep. NTIS $3.75.

A study to determine the nature of the chemical species controlling the post-irradiation conductivity of hydrocarbon polymers and to explore the effects of incorporating known chemical groups in suitable polymers as a guide to formulation of improved insulating materials for use in the capacitors for ion chamber dosimeters is described. Experimental methods and apparatus, apparent conductivities of typical polymers, the nature of post-irradiation conductivity, comparison with Fowler's trap controlled conductivity theory, identification of the trapping species or recombination site, and incorporation of polymer groups along the polymer chain through copolymerization are discussed. It was concluded that post-irradiation conductivity in styrene-based polymers is by electrons or holes and the decay of conductivity can be influenced by incorporation of suitable trapping species in the polymer. (WHK)

5817 INFLUENCE OF GATEMETAL ON γ-RAY INDUCED DEFECTS IN MOS STRUCTURES. Leuenberger, F. (Centre Electronique Horloger SA, Neuchatel, Switzerland). Z. Angew. Math. Phys.; 23: No. 6, 1020-1022(25 Nov 1972).

The effects of gamma radiation on the C-V characteristics of MOS capacitors made of $5\Omega \cdot$cm n-type silicon with aluminum field electrodes and with molybdenum-gold field electrodes are graphed and discussed. (WHK)

5818 GAMMA AND NEUTRON DAMAGE OF SILICON SOLAR CELLS: FUNDAMENTAL DATA FOR RADIOISOTOPE MEASUREMENTS. Usami, A. (Inst. of Tech., Nagoya, Japan). Nagoya Kogyo Daigaku Gakuho; 23: 305-311(Mar 1972). (In Japanese).

The reduction of minority carrier lifetime by gamma irradiation is strongly dependent on the sample type P/N or N/P, and the effect of chemical impurities such as Cu and Ni on radiation resistance is rather remarkable in N/P-type than in P/N-type samples. The radiation damage constant, K, of the silicon solar cells is defined as $1/\tau_i - 1/\tau_0 = K \cdot \phi$. Minority carrier life time before gamma-irradiation in bulk region of the cells can be estimated by fitting the observed spectral response curve to the calculated ones as life time parameter. The damage constant, K, in gamma-irradiated n-type floating zoned and pulled bulk P/N-type silicon solar cells and in p-type pulled bulk N/P-type cells increases as the bulk region dopant concentration increases. The modified damage constant, $1/Li^2 - 1/Lo^2 = K_L \cdot \phi$ is obtained from the drop rate of the spectral response in the wave length range of $0.8 \sim 1.0\ \mu$. Values of K_L in gamma-irradiated P/N-type cells contaminated with Cu or Ni are slightly smaller than in those of non-doped ones. On the contrary, values of K_L in gamma-irradiated N/P-type cells contaminated with Cu are smaller by about one order than those in non-doped ones. Effects of oxygen, dopant and Cu contamination on the damage constant of P/N and N/P-type cells are slightly observed under fast neutron irradiation. It is concluded that the more radiation-resistant N/P-type cell can be made by appropriate copper-doping. (auth)

5819 RADIATION DEFECTS IN DEVICES. Gregory, B. L. (Sandia Labs., Albuquerque, NM). pp 302-314 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973). From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

A detailed knowledge of defect behavior in devices is the basic tool required to design "radiation-hardened" structures for nuclear and space radiation environments. Since device materials, geometries, and operating conditions may differ drastically from bulk material experiments, the prediction of defect behavior in devices from bulk data is not always straightforward. This requires that many parameter measurements be made in devices themselves. Nonequilibrium measurements, which are essential to understand defect behavior in devices, can be performed with relative ease in device structures. For example, the effects of excess minority carriers on defect formation and reordering can be studied simply by injecting carriers into a device active region with a forward-biased junction. The present paper explores a variety of device studies which illustrate the types of data which can be obtained and the utility of this data in designing radiation-tolerant devices. Neutron-irradiated p-n junctions and junction field-effect transistors are discussed to show the effect of neutron-produced traps on device behavior. These measurements provide basic data for determining the defect energy levels and capture cross sections. The use of radiation damage data to design tolerant devices is illustrated by studying modern, narrow-base, bipolar transistors. The role of defects in the space-charge regions and quasi-neutral regions of this device is examined to demonstrate the limiting design parameters. The results of these studies were used to design and fabricate devices which are an order of magnitude more tolerant to fast neutrons than existing designs. (auth)

5820 EFFECT OF IONIZING RADIATIONS ON METAL-POLYMER-SILICON STRUCTURES. Ai, Bui; Carchano, H.; Sanchez, D. (Université Paul Sabatier, Laboratoire de Genie Electrique, 2, Rue Camichel, 31071 Toulouse, Cédex, France). Appl. Phys. Lett. 22: No. 3, 108-110 (1 Feb 1973).

The effect of electronic bombardment on metal-polymer-silicon structures is considered. The polymer film was obtained by polymerization of monomer vapor (styrene) in an ac glow discharge. The relative dielectric constant of the films is 3 and the dissipation factor is 0.01. Under 25-keV electronic bombardment at various flux levels and with different polarizing voltages applied, the shifts of the C(V) curve are always in the opposite direction to that induced by the polarizing voltage. The displacement under irradiation is lower than observed with the metal-silicon dioxide-silicon structure. It is remarkable that the radiation effects are not permanent. The structures do not have any memory of irradiation constraints. (auth)

5821 RADIATION EFFECTS ON MULTIPLIER PHOTOTUBES. Johnson, S. M. Jr. (EMR Photoelectric, Princeton, NJ). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 113-124(Feb 1973).

A multiplier phototube is an extremely sensitive device used to measure ultraviolet, visible and near infrared radiant energy. Physically, multiplier phototubes are high vacuum tubes which are comprised of a photocathode; an electron lens, which directs the photoelectrons onto the first dynode; a series of dynodes or amplifying stages; and an anode or collector. The use of multiplier phototubes in photometric and nuclear detectors for satellite systems has increased dramatically within the last few years. Because many of these systems are subjected to either natural or artificially created radiation, such as encountered in the Van Allen belts, or the South Atlantic anomaly, or galactic or solar cosmic radiation, a study of the behavior of these tubes under such conditions has become necessary. This paper summarizes the work of EMR and that of many other investigators, and discusses degradation of optical windows used; effects on photocathodes and dynodes; effects on noise, dark current and resolution. A list of conclusions is given. (42 references.) (auth)

5822 GENERAL PROOF OF THE β DEGRADATION EQUATION FOR BULK DISPLACEMENT DAMAGE. Messenger, G. C. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 809-810(Feb 1973).

A general proof for the β degradation equation in displacement producing radiation environments is presented. The proof is straightforward for the base component of damage. An extension of the proof encompasses damage in the base emitter field region to the extent it can be related to the emitter time constant. The derivation assumes a significant post-radiation common emitter current gain ($\beta > 3$). (auth)

Miscellaneous Instruments

Refer also to abstracts 5461, 5481, 6501, and 7340.

5823 (CEA-CONF-2165) SUSCEPTIBILITY TO PARASITES OF PULSED NUCLEAR MEASUREMENT ENSEMBLES. Buisson, J. (Commissariat A L'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1973. 14p. (In French). (CONF-730108-2). Dep. NTIS (U.S. Sales Only).

From Symposium on Nuclear Power Plant Control and Instrumentation; Prague, Czechoslovakia (22 Jan 1973).

In neutron control installations, the measurement ensembles most perturbed by parasites are usually those functioning in the pulse regime. An analysis is presented of the action mechanism of parasites and it is shown that whatever the origin (parasites carried by the sector, radiated parasites, or potential differences between grounds), the parasites are always shown by the same phenomenon: the circulation of a current on the shielding of the mechanism; the only cause of measurement perturbation is the action of this current. The action mechanism of this current was studied at the level of the connectors, the shielding of the electronics, and the cables. The transfer impedance concept, characterized by immunity to cable parasites, is defined. The results obtained with different cables, particularly with a new mu-metal shielded cable recently developed, are given. (tr-auth)

5824 (HEDL-TME-7260) PLUTONIUM FUELS LABORATORY DATA ACQUISITION SYSTEM OPERATING PROCEDURES. Markillie, W. R.; Crow, V. L. (Hanford Engineering Development Lab., Richland, Wash.). [nd]. Contract AT(45-1))2170. 58p. Dep. NTIS $5.45.

The procedures to be used in operating the Plutonium Fuels Laboratory Data Acquisition System are described. The system consists of carefully integrated equipment and program modules. It is assumed that the reader is familiar with the operation of the equipment used in the system. The operation of this equipment is described in Operator Manual–SEL 810A/810B Computer/Peripheral, Systems Engineering Laboratories Document Number 302-095064-003, September 1969. The key program, the Foreground/Background Operating System (FBOS) Program, is used to provide the multiprogram, real time environment required to execute up to eight remote terminal (foreground) jobs concurrently with a single batch (background) job. (auth)

5825 (JINR-P11-7005) BINARY-TO-DECIMAL CONVERTER PERFORMED IN CAMAC SYSTEM. Kolpakov, I. F.; Nikityuk, N. M.; Urmanova, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A serial binary-to-decimal converter is described, which is performed in the CAMAC system. A maximum of 24 binary data bits can be loaded into the converter. A maximum decimal number is 16777215(10). Time of the conversion is about 10 μsec. The binary-to-decimal converter is used for data extraction, in particular, from binary scalers to computer, decimal display, print unit, a punch tape unit, and teletype. The converter was designed at the Laboratory of High Energies. (auth)

5826 (K–1841) COMPUTER CONTROL AND DATA PROCESSING FOR FIFTEEN ISOTOPE RATIO MASS SPECTROMETERS. Sulfridge, C. (Oak Ridge Gaseous Diffusion Plant, Tenn.). 8 May 1973. Contract W-7405-eng-26. 13p. Dep. NTIS $3.00.

A small computer system has been interfaced to 15 isotope ratio mass spectrometers which operate continuously. Performance of the system has been highly satisfactory since it was put in operation early in 1971, and has enabled more effective utilization of the spectrometers. The system includes a PDP-8/I computer with 8K core memory, a 32K disc, one digital radiometer, an input teletype, and an output teletype. The system automatically times the analysis events for individual spectrometers, collects the analysis data, performs the necessary calculations, stores certain results, and prints all results on the output teletype. The foreground/background concept of programming was used with the foreground priority program performing essential spectrometer timing and data acquisition. The background program, which is written in FOCAL, allows the analyst to communicate with the computer by selecting one of several options which represent the various functions the computer will perform. This system was assembled and initially programmed by Tennecomp Systems Inc. from specifications provided by the Oak Ridge Gaseous Diffusion Plant Laboratory. System description, operation, and advantages are discussed. (auth)

5827 COMPARISON BETWEEN QUADRUPOLE AND MAGNETIC MASS SPECTROMETERS FOR USE IN SIM. Ruedenauer, F. G. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Seibersdorf, Austria). Vacuum; No. 11, 609-612(Nov 1972).

Both double focusing magnetic mass spectrometers and quadrupole analysers are used in commercial Secondary Ion Mass (SIM) instruments. A comparison between the two methods has to consider the following items: sensitivity, spectrum interpretation, simplicity of operation, and price. For instruments of similar size the acceptance volume in phase space is similar for both systems, the quadrupole being somewhat superior in the low mass range, the magnet in the high mass range. The magnet, however, accepts ion energies which are 2 orders of magnitude higher than in the quadrupole and therefore has a correspondingly higher sensitivity. Spectrum interpretation is easier with the magnet, especially due to its lower mass discrimination. Also, energy analysis can give additional information in SIM. Whereas the double focusing magnetic analyzer has energy analysis of secondary ions already built in, the quadrupole has to be especially adapted to an energy analyzer. Points in favor of the quadrupole are simplicity of operation, the linear mass range and the fast switching capability which lends itself to computerization as well as the considerably lower price. (auth)

5828 CAMAC HARDWARE, MODULES, BRANCH DRIVERS, AND CONTROLLERS (5 MAR 1973) (ENGINEERING MATERIALS). (Los Alamos Scientific Lab., N. Mex.). (CAPE-2333). 32 drawings.

5829 NEW LAMINATED BUS FOR THE NUCLEAR INSTRUMENT MODULE SYSTEM (27 NOV 1973) (ENGINEERING MATERIALS). (Los Alamos Scientific Lab., N. Mex.). (CAPE-2337). 7 drawings.

5830 METERING APPARATUS FOR NUCLEAR REACTORS. Kuwabara, J. (to Atomic Power Development Associates, Inc.). U. S. Patent 3,724,268. 3 Apr 1973. Filed date 28 Aug 1970. 8p.

An apparatus for determining the temperature and/or flow of a conductive fluid through a nuclear reactor subassembly is described. It includes a pair of permanent magnets, with or without pole pieces, which is installed toward the end of the subassembly to provide a magnetic field in the open channel in the subassembly, and a pair of electrodes which is inserted into the open channel and supported from internal structure of the nuclear vessel, which is independent of the subassembly. (Official Gazette)

5831 USE OF A SLIT COLLIMATOR IN THE STUDY OF α PARTICLE DIFFRACTION. Zheltonog, K. S. pp 124-128 of Prikladnaya Yadernaya Spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5832 PROGRAM "SPEKTR-1". Tokarevskii, V. V. pp 226-232 of Prikladnaya Yadernaya Spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5833 EXPERIMENTAL CHANNEL OF A NEW TYPE FILTER TO OBTAIN TYPICAL DEVIATIONS. Warzanskyi, W. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 16: No. 80, 661-670(1972). (In Spanish).

An experimental filter channel for obtaining typical deviations is described, based on the design technique of RC-active filters, specifically of filters with Tchebychev transmission characteristics. The numerical design phase was realized by means of programs for P-101 or P-203 type calculators. The channel is completed with a rectification and averaging step in which an excellent linearity and low sensitivity threshold are obtained. A very low frequency oscillator for the calibration of the filter is also described. The transmission characteristics of the filter were determined and there is good agreement between the experimental results and the predicted characteristics. (tr-auth)

5834 ULTRASONIC THERMOMETER: CONSTRUCTION, APPLICATION, AND OPERATING EXPERIENCE. Tasman, H. A.; Schmidt, H. E. (Commission of the European Communities, Karlsruhe, Ger.). High Temp.-High Pressures; 4: No. 4, 477-481(1972).

From 3rd European conference on thermophysical properties; Turin, Italy (20 Jun 1972).

The principles of ultrasonic thermometry are briefly outlined and the technique is compared with other methods of measuring high temperatures (>2000°C). When measurements are required on inaccessible objects, for example of fuel temperature in a nuclear reactor, the ultrasonic thermometer has certain advantages: it is more rugged than thermocouples, and changes in structure and chemical composition affect it to a lesser degree than thermoelectric devices. Laboratory tests are described in which temperatures up to 2400°C were measured over at least 100 h with a precision of ±30°K with a thoriated-tungsten sensor 50 mm long. Possible ways of improving the temperature resolution are discussed. (auth)

5835 RANDOM TAIL PULSE GENERATOR. Burtis, D. W. (Time Zero Corp., Torrance, CA); Brown, M. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 209-215(Feb 1973).

A random pulse generator for simulating detector pulses has been designed that utilizes a charge control concept to provide controlled voltage transitions at average rates from 10 Hz to 1 MHz. These voltage transitions may be coupled to a charge sensitive amplifier system via the standard calibration capacitor to induce impulses of charge, thereby closely approximating the signal from a detector. Between pulses, the voltage decays in an exponential fashion not unlike any tail pulse generator. However, the voltage transition (or step) is independent of the decay, thus recurring steps will ride up the tail of the decay, eliminating the step amplitude dependance upon decay time (τ_d) found in other tail pulse generators. This last fact permits repetition rates far in excess of the $^1/_8\, \tau_d$ limitation commonly incurred. To complement this pulse shaping ability, the clock circuit provides both periodic triggers and random triggers. The random time distribution has been measured at several rates and verified to be Poisson. Pulse shaping controls and a polarity switch provide versatility and an output buffer amplifier allows cable termination without affecting the pulse shape. The amplitude has been measured over the frequency range of 10 Hz to 100 kHz and was found to vary less than ±0.05%. The random pulse generator is packaged in a double width NIM and utilizes ±12 volts and ±24 volts for the power source. (auth)

5836 CAMAC HIGH RESOLUTION TIME INTERVAL METER. Wiedwald, J. D. (Univ. of California, Livermore). IEEE (Inst.

Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 242-245 (Feb 1973).

A four-channel Time Interval Meter (TIM) with one-eighth nanosecond resolution was designed and packaged into a triple width CAMAC module. The TIM has a common Start and four Stop Inputs with a total range of 65,536 nanoseconds (plus an overflow bit). The basic accuracy is dependent on an internal 125 MHz clock. Preliminary measurements indicate a standard deviation of 185 pseconds. (auth)

5837 SLEW KNOBS: AN ALTERNATIVE TO THE LIGHT PEN. Chalmers, R. A. (Lockheed Missiles and Space Co., Inc., Palo Alto, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 348-351(Feb 1973).

Use of a manually operated shaft encoder to increment or decrement a word in memory is described by which means it is possible to control both a computer display and the simple data processing functions normally performed in the nuclear physics laboratory. The relative merits of this technique and the light pen are discussed. (auth)

5838 CAMAC: A REVIEW AND STATUS REPORT. Costrell, L. (National Bureau of Standards, Washington, DC). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 557-561(Feb 1973).

CAMAC is a modular instrumentation system for transmission of digital data between instruments and between instruments and computers and computer peripherals. The system is described in a general way and the history of the CAMAC development, its expanding utilization in various fields and its current status are discussed. This is an introductory paper delivered at the 1972 Nuclear Science Symposium and is followed by papers that discuss CAMAC in greater detail. (auth)

5839 CAMAC SPECIFICATIONS. Kirsten, F. A. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 562-568(Feb 1973).

The experience with CAMAC installations resulting from its widespread use has inevitably led to suggestions for changes in the specifications. The NIM and ESONE Dataway Working Groups spent nearly a year discussing these suggestions during the recently completed process of rewriting and revising the CAMAC specifications. Some of the suggestions were included in the revised specification after careful evaluation of any compatibility problems that might arise. Others were felt to lie outside the intended scope of the specification. The scope and intent of the CAMAC specification is briefly discussed. Then the significant additions and changes to the Dataway specification are listed, along with some background information. Reference is also made to the information contained in the document "Supplementary Information on CAMAC System." (auth)

5840 CAMAC SYSTEM FOR REMOTE DATA ACQUISITION. Furst, R. C.; Wiedwald, J. D. (Univ. of California, Livermore). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 570-573(Feb 1973).

A CAMAC System has been developed at Lawrence Livermore Laboratory to interface with a remotely located computer. The system operating characteristics and several modules developed at LLL are described. These modules are two read-only controllers—one for single crate and one for multiple crate operation, a serial peak detector, three different time interval meters, a serial bit stream generator, a parallel input gate, an A/D converter and its associated modular memory, and a pulse generator. A CAMAC data display which reads a serial bit stream but is not a CAMAC module is also described. (auth)

5841 VERSATILE, MODULAR READOUT SYSTEM FOR CAMAC SCALERS. Horelick, D. (Stanford Univ., CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 574-580(Feb 1973).

A display and readout system for CAMAC scalers which has been in use at SLAC for over a year is described. Flexibility and versatility are the keynotes of the system, which includes a modular quad display unit employing highly readable Nixie tubes. Other units which may be connected to the expandable bus include an X-Y scope display and a preset count module. The system employs a simple, but versatile CAMAC crate controller. Capability for connection to computers is included, and the system has been interfaced to several different computers. (auth)

5842 STANDARD SOFTWARE FOR CAMAC. Dhawan, S. (Yale Univ., New Haven); Thomas, R. F. Jr. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 581-585 (Feb 1973).

The NIM Committee and ESONE have formed working groups to study the problems of CAMAC software. The results which have been obtained to date are summarized. The NIM Software Working Group has endorsed six FORTRAN-compatible subroutines for CAMAC software interface, and the ESONE Software Working Group has proposed a high-level CAMAC language. (auth)

5843 CAMAC BRANCH DRIVER FOR THE VARIAN 620 SERIES COMPUTERS. Mortara, L. B. (Kitt Peak National Observatory, Tucson, AZ). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 680-684(Feb 1973).

A CAMAC branch driver for the Varian 620 series computers has been designed and built by Kitt Peak National Observatory for use in several real time control and data acquisition systems currently being assembled. Its principal feature is a stack register which serves as a work area to assemble the information needed for a CAMAC cycle. The stack has sixteen levels which serve to preserve the existing status under interrupt conditions without requiring special software routines. A priority interrupt system with 23 levels and a direct memory access channel are also included. The system is self contained, needing no auxiliary support within the host computer. Highlights of the structure and general characteristics are described. (auth)

5844 VARIABLE WORDSIZE CAMAC TAPE CONTROLLER. Oakes, A. E.; Andreae, S. W.; Rudden, R. J. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 685-689(Feb 1973).

A CAMAC magnetic tape controller is described which converts 7-track tape characters into 12, 16, 18 or 24-bit words as selected by the computer driving the CAMAC system. Regardless of the wordsize of the driving computer, data flows to and from memory in single-word transfers, in the minimum possible time and with no loss of memory space. The controller has been designed to operate most 7-track tape decks. This is accomplished by placing the tape operation algorithm logic in a separate chassis, the tape synchronizer. The CAMAC tape controller module may be used with nearly any 7-track tape deck but each kind of deck requires a different synchronizer. Up to eight similar tape decks may be operated at one time by a single controller and synchronizer. (WHK)

5845 RICE: A MULTI-PROCESSOR ACQUISITION AND ANALYSIS SYSTEM INCORPORATING CAMAC. Jones, H. V.; Buchanan, J. A.; Mann, D.; McGrath, K.; Jones, M. N. (Rice Univ., Houston, TX). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 691-697(Feb 1973).

A two-processor data acquisition and analysis system incorporating CAMAC is discussed. The processors are a conventional mini-computer and a micro-programmed I/O processor which effects a programmable interface between the mini-computer and CAMAC. Hardware-software design considerations for a multi-processor acquisition and analysis system and procedural level computer/CAMAC interaction are also discussed. (auth)

5846 EXPERIMENTAL DETERMINATION OF THE TRANSMISSION FUNCTION OF A NEUTRON CHOPPER. Brown, R. A. (United Kingdom Atomic Energy Authority, Aldermaston, Eng.); Ross, D. K. Nucl. Instrum. Methods; 109: No. 2, 313-316(1973).

A method is described for extracting the transmission function of a curved slit rotor directly from the experimental data in the form of a polynomial. The function obtained for such a rotor is shown to have an asymmetry very similar to that found for a parallel curved slit rotor by numerical calculation. (auth)

5847 HALF-LIFE MEASUREMENTS WITH UNEQUAL TIME BINS. Draper, J. E. (Univ. of California, Davis). Nucl. Instrum. Methods; 109: No. 2, 397-398(1973).

For in-beam measurements of half-lives with pulsed accelerator beams it is often most effective to use ≈8 time bands of increasing width to cover a wide range of possible lifetimes. The method of analysis is given. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstract 5417.

5848 (CONF-730618-2) DEVELOPMENTS IN THE ORNL PROGRAM. Love, L. O. (Oak Ridge National Lab., Tenn.). [nd]. 24p. Dep. NTIS $3.25.

From 8th international electromagnetic isotope separator conference; Skovde, Sweden (12 Jun 1973).

A general review of developments in the field of electromagnetic separation of isotopes at the Oak Ridge National Laboratory is presented. (JFD)

5849 (ORNL-TM-4251) ISOTOPE PROGRAM (5000) PROGRESS REPORT FOR QUARTER ENDING MARCH 31, 1973. Gillette, J. H. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 18p. Dep. NTIS $3.00.

Work accomplished during Jan. to April 1973 in the Isotope Program (5000) is reported. Information is included on: target fabrication and development; use of ^{110m}Ag as a tracer for determining braze alloy flow patterns for brazing done on earth and in space; stable isotope separations; radioisotope separations to obtain highly enriched ^{242}Pu; osmium separations; development status of 180°C Oak Ridge Sector Separator development; and quantities of stable isotopes and radioisotopes prepared. (LCL)

5850 (TID-26277, pp 29-44) SOURCE MATERIALS FOR NUCLEAR ENERGY. 1973. 1972 Atomic Energy Programs: Operating and Developmental Functions.

An overall view of the supply and demand situation of source material for nuclear energy is presented, and the USAEC activities during 1972 devoted to eventually ending the Government monopoly of uranium enrichment services are discussed. Information is included on: uranium supply status; nuclear fuel cycle; need for enrichment services; technical developments in enrichment methods; uranium enrichment operations; production of nuclear materials such as ultra-high-purity ^{238}Pu, man-made radioisotopes, heavy water, and reprocessed fuels; waste storage; sales of radioisotopes; and the development of programs and methods for safeguarding nuclear materials. (LCL)

5851 PRODUCTION OF ENRICHED URANIUM BY THE GAS CENTRIFUGE PROCESS. Nair, R. (Indian Inst. of Tech., Bombay). Met. Eng.-IIT (Indian Inst. Technol.) Bombay; 249-254 (1970-1971).

A techno-economic study of the three main types of gas centrifuges used for enriching uranium is presented. (Indian Sci. Abstr.)

5852 IMPROVEMENTS TO URANIUM HEXAFLUORIDE PURIFICATION PROCESSES. Cousin, P.; Henry, P.; Leveque, C. Roubeix, G. (to Commissariat a l'Energie Atomique). French Patent 2,128,047. 20 Oct 1972. Filed date 2 Mar 1971. 9p. (In French).

A process is described for separating uncondensable gases from UF$_6$ under normal industrial operation conditions, applications to UF$_6$ isotopic separation installations being envisaged. The UF$_6$ and uncondensable gases are liquefied under pressure. The mixture is then introduced at an intermediate level along a plate column, a more volatile and less easily solidifiable substance, e.g., ClF$_3$, being introduced in the upper part of the column. This latter substance is chemically inert with respect to the mixture and does not form azeotropic compounds with it. The gaseous effluents at the top of the column are cooled in such a way as to liquefy the substance at a temperature corresponding to its boiling point under the pressure existing in the column. The trickling of this substance down the column carries the hexafluoride to the bottom of the tube, a process which opposes it being carried up by the uncondensable gases. These gases can thus be eliminated from the installation by continuous purging. (FR)

5853 METHODS OF CALCULATIONS FOR A STEP CASCADE FOR ENRICHING URANIUM. Yamashita, S. (Sumitomo Atomic Energy Industries, Ltd., Tokyo). J. Nucl. Sci. Technol. (Tokyo); 9: No. 8, 480-489(Aug 1972).

A method of calculation is proposed for finding the exact total flow rate of the entering stream fed to the separator in a step cascade in steady state and without losses. The method can be applied without approximation even to step cascades constituted of separators with large values of separation factor. A method of approximation is also presented for application to the case of infinitesimal separation. The reflux in each step can be chosen such that the total flow rate of the entering stream fed to the separator in the step cascade is minimized. The effect on the total flow rate of the entering stream in the step cascade brought by such factors as the mole fraction of production, the number of steps, and the separation factor are revealed from the results of calculation using these methods. The optimization of the stripping section is found to be important for the design of plants producing low-enriched uranium required for nuclear power generation. (auth)

Isotopic Power Sources

5854 (CONF-730402-(P1-2), pp 637-646) NUCLEAR POWERED HEART PACEMAKERS: BIOMEDICAL APPLICATION OF RARE EARTHS. Recchia, A. L.; Kolenik, S. A. (ARCO Nuclear Co., Leechburg, PA). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

A brief description is given of the nuclear-powered cardiac pacemaker developed by ARCO Nuclear. This device which is totally implanted is presently undergoing clinical trials in animals at the National Heart and Lung Institute and human implants are anticipated in the early part of 1973. The nuclear pacemaker which regulates the heartbeat has been designed to operate for ten years or more. In order to meet this design life, getters made of rare earths are employed to maintain a high-quality vacuum within the nuclear battery of the system. The characteristics of these rare earth getters as they relate to operation of the nuclear pacemaker are also discussed. The getter is called Ceralloy 400. (auth)

5855 (LA-5142) OXIDATION BEHAVIOR OF TRANSIT CAPSULE T-47. Morgan, J. R.; Bronisz, S. E. (Los Alamos Scientific Lab., N. Mex.). Apr 1973. Contract W-7405-eng-36. 12p. Dep. NTIS $3.00.

Transit Capsule T-47, which had been dropped onto a concrete pad at terminal velocity, was heated by an internal electric heater to simulate the heat generation in a flight capsule during exposure to a natural environment. Catastrophic oxidation of the tantalum-alloy strength member and liner occurred, exposing fuel simulant after 4.5 days. The progress of capsule deterioration was monitored by time-lapse cinematography. (auth)

5856 (LIB/Trans-437) POTENTIAL PERFORMANCE OF A TRITIUM-POWERED ISOTOPIC BATTERY. Voinov, M.; Tannenberger, H. 1972. Translated by K. G. McLaren (Australian Atomic Energy Commission Research Establishment, Lucas Heights) from French. 20p. (CONF-720519-5). Dep. NTIS (U. S. Sales Only) $3.00.

From 2nd international symposium on power from radioisotopes; Madrid, Spain (29 May 1972).

Calculations were made for a model isotope-powered generator based on direct collection of electrons emitted in the radioactive decay of tritium. The principal parameters in the calculations are the thickness and electrical resistivity of the dielectric which separates the emitter and the collector. When the voltage on the dielectric is kept below its breakdown voltage, the energy conversion efficiency is less than 1%. (auth)

5857 (LIB/Trans-438) PROSPECTS FOR RADIOVOLTAIC ENERGY CONVERSION. Bomal, R.; Manin, A.; Steinschaden, K. 1972. Translated by K. G. McLaren (Australian Atomic Energy Commission Research Establishment, Lucas Heights) from French. 39p. (CONF-720519-4). Dep. NTIS (U. S. Sales Only) $4.00.

From second international symposium on power from radioisotopes; Madrid, Spain (29 May 1972).

Experimental results and progress achieved in radiovoltaic energy conversion are reviewed. Limits are given for various processes which have been studied or are being studied at present. At the present time tritium appears to be the isotope with the greatest potential for producing long-life microgenerators capable of delivering several microwatts (electrical). Problems in improving the overall "source + semiconductor" efficiency and the compactness of generators are discussed. From this point of view, the use of n–p junctions optimized for conversion of tritium beta particles and the development of technology for making sources with higher performance are essential. (auth)

5858 (MDC-G-3156) PLUTONIA/CURIA COMPATIBILITY TESTING. Quarterly Report No. 16, July–September 1972. Watrous, J. D. (McDonnell Douglas Astronautics Co., Richland, Wash. Donald W. Douglas Labs). Jan 1973. Contract AT(45-1)-2138. 60p. Dep. NTIS $5.45.

Chemical analyses of control specimens from early compatibility work in the program were completed. Volatile impurities were removed from refractory metal alloys after more than a year at 1800°C, thereby purifying the alloys. Titanium, zirconium, and hafnium transferred between adjacent refractory metal alloys at 1800° and 2000°C but not at 1500°C. Mass transfer and volatility of refractory metal alloys is not a problem for current thermoelectric systems. Several conclusions relevant to helium release, dimensional changes, and structural stability were derived from results of the plutonia fuel aging experiments where curium-242 oxide was added to plutonium-238 oxide to accelerate helium generation. Fuel form quality and reactions with container materials made interpretation difficult. The helium released from both plutonia and plutonia molybdenum cermet (PMC) fuel forms, with and without curia additions, appeared to be related to chronological or pseudo-chronological age and thermal treatment. Almost total helium release occurred in plutonia at 850°C but not in PMC aged at the same temperature. Total helium release occurred in 1200°C aging. The PMC fuel forms swelled during aging from the as-fabricated 89% to 92% of theoretical density. The plutonia exhibited shrinkage during aging from the as-fabricated 52% to 74% of theoretical density. Plutonia fuel forms, with and without curia additions, exhibited roughly comparable structural changes under similar thermal treatment. The PMC + Cm fuel form had an inferior initial structure resulting in indeterminate aging results. Accelerating plutonia fuel aging by the addition of curium-242 oxide appears technically sound, provided that adequate quality fuel forms are available as starting material. In support of the multi-hundred watt radioisotope thermoelectric generator (MHW-RTG) program, seven plutonium-238 oxide fueled and six control specimens have been assembled and are undergoing exposure in an effort to determine systems interactions. Short-time exposure (1000 to 1500 hr) will be completed during the next quarter at a maximum temperature of 1440°C. Test assemblies include all materials used in the MHW heat source, together with selected specimens in a comparable thermal gradient intended to mock-up total system variables. Tensile specimens have been included for post-test evaluation of iridium cladding using a DWDL-developed high-strain-rate tensile testing device. This device has been checked and is ready for use in the program. (auth)

5859 (MDC G-4403) PLUTONIA/CURIA COMPATIBILITY TESTING. Quarterly Report No. 17, October–December 1972. Watrous, J. D. (McDonnell Douglas Astronautics Co., Richland, Wash. Donald W. Douglas Labs.). Mar 1973. Contract AT(45-1)-2138. 32p. Dep. NTIS $4.00.

Electron-beam microprobe analyses reconfirmed vapor transport of both rhenium and plutonia in Task 1 test capsules exposed at 1800°C for 15,000 h or more. Effects are to reduce temperature gradients within the capsule and also to remove metal from hot areas. The microprobe was also used to determine that titanium and hafnium transport readily between Task 2 refractory metal alloy containers at 1800°C, forming massive precipitates. This transport did not occur after 5000 h at 1500°C, and in all probability current or proposed space thermoelectric systems would not be affected at typical operating temperatures of 900° to 1200°C. Limited probe work remains on Tasks 1 to 3 materials to complete the current effort on these tasks. Visual and metallographic examination has been completed on Task 5 Multi-Hundred Watt (MHW) mockup test assemblies; MHW is being developed for the LES 8/9 mission. Plugging of the vent through the iridium container occurred in two of three capsules exposed at maximum temperatures of 1440°C for 1250 h. Plugging was apparently caused by iridium transport into the 0.0008-in. diameter electron-beam-drilled hole. Black deposits, believed to be plutonia also transported, especially above the fuel but not in massive amounts or discrete layers. Graphite erosion occurred immediately opposite the vent hole, but no other degradation was observed in the graphites. A thin reaction layer was observed in the iridium in contact with the plutonia as a result of tungsten present in the plutonia, which did not appear to result in damage to the bulk mechanical properties of the iridium. Microsize iridium tensile specimens, exposed in contact with either plutonia or graphite, retained both strength and ductility equivalent to comparably exposed control specimens when tested at a high strain rate and expected impact temperature of 1400°C. Strength remained the same as control specimens which were not exposed to plutonia. Ductility was reduced from 58% elongation for control specimens to 49% elongation for specimens exposed at ~1370°C with and without a subsequent thermal pulse to 1950°C. A number of tensile specimens exposed at somewhat lower temperature (~1200°C) exhibited reduced ductility in the lower temperature (~1000°C) areas of the specimen. (auth)

5860 (MLM-2040) MOUND LABORATORY ISOTOPIC POWER FUELS PROGRAMS: JANUARY–MARCH 1973. (Mound Lab., Miamisburg, Ohio). 30 Apr 1973. Contract AT-33-1 Gen-53. 32p. Dep. NTIS $4.00.

Progress in the isotopic fuels program during Jan. to Apr. 1973 is reported. Preparation and process studies of ^{238}Pu fuels continued. Seven pressed plutonium oxide spheres were fabricated as part of the multihundred watt testing program. The effect of calcination temperature, HF concentration, HNO_3 concentration, and HNO_3 volume on the dissolution of oxalate-precipitated $^{238}PuO_2$ was investigated. A calcination temperature of 500°C is recommended. The study shows that, if the HF to PuO_2 ratio is maintained at 10 mg/g $^{238}PuO_2$, the volume of concentrated HNO_3 can be varied from 2 to 7 ml/g $^{238}PuO_2$ without affecting dissolution. Graphite dies used in the pressing of plutonium–molybdenum–cermet (PMC) fuel discs were found to contain recoverable quantities of ^{238}Pu. An autoradiographic technique determined that the Pu had diffused into the die body but that essentially all of the Pu was within ½ in. of the surface. In concert with the location of the Pu, methods were developed to separate the plutonium-rich section from the die, pulverize it, and leach the pulverized graphite with HF-conc HNO_3 solutions. Slip casting techniques were developed to fabricate special ceramic fixturing for use in multihundred watt sphere transfer vessels. Capsule design and testing continued. Results from scanning electron microscopy examinations of cracks on the surface of an Ir hemisphere and of laser-drilled holes in Ir sheets are discussed. An ultrasensitive He leak detection method using a quadrupole mass spectrometer to He leak check welds on a fueled plutonia heat source is described. With the appropriate standard helium leaks, this method should be capable of testing helium leaks in the 10^{-14} std. cc (He) sec^{-1} range. (LCL)

5861 (ORNL–4328) ORNL ISOTOPIC POWER FUELS QUARTERLY REPORT FOR PERIOD ENDING JUNE 30, 1968. Lamb, E. (Oak Ridge National Lab., Tenn.). Sep 1968. Contract W-7405-eng-26. 43p. Dep. NTIS $4.25. Declassified 29 Mar 1973.

The thermal conductivity of curium sesquioxide was estimated for temperatures up to 1450°C. Compatibility capsules of tantalum, Ta–10% W, T–111, molybdenum, TZM, tungsten, and W–26% Re containing $^{244}Cm_2O_3$ for 1000 hr at 1850°C were examined metallographically. Conditions and results of diffusion bonding of tungsten with Ta–Ta_2C cermets and tantalum foils were investigated. The results of simulated emitter-to-capsule brazes made by using several experimental brazing alloys and tungsten were evaluated. Experiments were continued to obtain characteristics (rupture life, electrical resistivity, specific heat, total hemispherical emittance, and vaporization) of potential containment materials in their operating environment. Techniques were developed for fabricating tungsten capsules for containing curium fuels. Thulium oxide microspheres (an excellent stand-in for curium oxide) were successfully prepared by the sol-gel method. Design of vented and nonvented thermionic capsules for containing 1 kw of $^{244}Cm_2O_3$ was continued. Two complete sol-gel runs were made to prepare $^{244}CmO_2$. The most promising results from weldments of superalloys, which are being considered for the encapsulation of ^{90}Sr fuel, made under various welding conditions were evaluated. Equations for the thermal conductivity of $^{90}SrTiO_3$ fuels of different ages were derived by using least mean squares. The leach rates of several ^{90}Sr titanate fuels in distilled water were determined for a period of 47 days. Additional tests were carried out to measure the surface temperature of a heat source capsule buried in soil and to determine the thermal conductivity of the soil. The total helium released from PuO_2 microspheres at temperatures up to 2000°C was measured, and theoretical studies of helium release from $^{238}PuO_2$ were initiated. Several additional attempts to prepare $^{238}PuO_2$ microspheres by the sol-gel process were unsuccessful, primarily due to equipment difficulties. Two fueled SNAP-21 capsules were inspected in a manipulator cell by a pulse-echo ultrasonic method. Four weld test specimens for the SNAP-23 program were welded while preheated to the expected temperature of an isotopically fueled capsule. (auth)

5862 (ORNL–4857) ORNL ISOTOPIC POWER FUELS QUARTERLY REPORT FOR PERIOD ENDING DECEMBER 31, 1972. Lamb, E. (Oak Ridge National Lab., Tenn.). Mar 1973. Contract W-7405-eng-26. 13p. Dep. NTIS $3.00.

Materials for testing with $^{244}Cm_2O_3$ at 900, 1100, and 1400°C are being procured. Welding of the inner and outer compatibility capsules is expected to be completed by March 1, 1973. The metals and alloys tested with $^{244}Cm_2O_3$ for 1,000 and 10,000 hr at 750°C were examined metallographically; the results indicated good compatibility. The potential ceramics chosen for a compatibility study with Cm_2O_3 are BeO, SiC, ZrO_2, and ThO_2. Preliminary studies of BeO and SiC showed the formation of low-melting phases, which resulted in the rejection of these two ceramics. Cells in the source fabrication facility have been repaired to provide the proper inert atmosphere for encapsulation of the compatibility samples. Neodymium oxide is being used as a stand-in for curium oxide during the adjustment and check-out of the mass spectrometer to increase the signal-to-background ratio and thus to increase the sensitivity of mass measurements at low specimen temperatures. Apparatus is being designed for the measurement of helium release rates from $^{244}Cm_2O_3$ pellets in the temperature range of from 500 to 1000°C. These data will provide new information on fuel form behavior in power conversion devices designed for lower temperature operation. The πMC particle size analyzer has been received and calibrated. With proper sample preparation, the instrument is capable of giving size distribution down to 0.1 μm. (auth)

5863 (ORNL-4890) ORNL ISOTOPIC POWER FUELS QUARTERLY REPORT FOR PERIOD ENDING MARCH 31, 1973. Lamb, E. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 12p. Dep. NTIS $4.00.

Hot-pressed pellets of $^{244}Cm_2O_3$ were prepared for compatibility exposures at 900, 1100, and 1400°C. All materials for the compatibility test couples were received and inspected, and the fabrication of the couples containing the curia pellets was completed. Test equipment systems for curia emissivity and solubility experiments were assembled, and checking of the equipment is in progress. The development of impact test procedures and particle size analytical techniques continued. Metallographic and electron-beam microprobe analysis of the fuel block and residual fuel used in the Kilowatt Curium Source Test is in progress. (auth)

5864 (SAN-858-5) MATERIALS SURVEY FOR A RADIOISOTOPE HEAT SOURCE FOR AN ARTIFICIAL HEART DEVICE. Bramer, S. E. (TRW Systems, Redondo Beach, Calif.). 19 Jun 1971. Contract AT(04-3)-858. Dep. NTIS $6.25.

A comprehensive material survey was undertaken to select materials and material combinations for the artificial heart radioisotope heat source. Material property and fabrication data were obtained from a review of the pertinent literature and discussions with material suppliers and fabricators. Fuel compatibility data were obtained from Mound Laboratory, Los Alamos Scientific Laboratory and Donald W. Douglas Laboratory efforts. Other material interaction data were obtained from past heat source technology programs. The refractory metal and noble metal alloys best meet the requirements for sufficient strength to ensure fuel containment, material compatibility and oxidation and corrosion resistance. The physical and mechanical properties of these materials are given and a summary of the single-layer, two-layer, and three-layer material systems for heat sources is presented. (auth)

5865 (SAN-858-22) PARAMETRIC ANALYSES FOR A RADIOISOTOPE HEAT SOURCE FOR AN ARTIFICIAL HEART DEVICE. Smith, T. H.; Lurie, H. (TRW Systems, Redondo Beach, Calif.). 31 Jan 1972. Contract AT(04-3)-858. 166p. Dep. NTIS $10.50.

Parametric analyses were performed to determine the optimum heat source configuration relative to previously determined selection criteria. Heat source sizes, weights, volumes, material interaction depths, and thermal expansion differentials between the various components were calculated for all candidate designs. These analyses included single-layer, two-layer, and three-layer designs of flat-ended and hemispherically-ended configurations of all material combinations under consideration. Selective and nonselective vent systems were designed to vent the fuel-generated helium from the heat source to retain and/or decay the ^{220}Rn to levels below the maximum allowable body burdens. The capsule wall thickness required to survive bullet impact, granite impact, and crushing was determined for the various configurations, and the thickness of a selectively-vented capsule required to survive creep due to the internal helium pressure was also determined. Based on these analyses, minimum required wall thicknesses were determined and an optimum design of each material configuration was generated. Forty-three candidate designs were scored against the selection criteria. The recommended system, which is currently being fabricated, is a right-circular cylinder consisting of a Pt-20Rh liner, a T-111 strength member, a Pt-20Rh clad and a nonselective pressure relief device/capillary tube assembly. The liner and clad are interconnected to seal off the strength member from external contamination. (auth)

5866 DECOMPOSED AMMONIA RADIOISOTOPE THRUSTER. Neudecker, J. W.; Cooper, K. C. (to United States Atomic Energy Commission). U. S. Patent 3,724,215. 3 Apr 1973. Filed date 19 May 1971. 6p.

A radioisotope heated propellant reaction control system for space vehicles is described. The energy from the decay of ^{238}Pu is used to heat and decompose ammonia propellant, and the decomposition products, nitrogen and hydrogen, are expanded through nozzles to provide desired increments of thrust. Three nozzles provide thrust levels of 10×10^{-3} to 100×10^{-3} lb_f at a specific impulse of 310 seconds in a pulsing mode. (Official Gazette)

Radiation Sources

Refer also to abstracts 5399, 5411, 5516, 5647, and 6475.

5867 (ORNL-4872) ANOMALOUS BEHAVIOR IN THE KINETICS OF PHASE TRANSFORMATION IN CsCl-KCl SYSTEM. Lin, K. H.; Braski, D. N. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 41p. Dep. NTIS $4.00.

With the development of the nuclear power industry in recent years, nuclear fission products have been receiving close attention because their impact on the environment depends upon the methods of disposition. One potentially useful fission product is an isotope of cesium with a mass of 137, having a long half-life (30 y) and relatively high radiation energy levels from negative beta particles and gamma rays. Cesium chloride has been the preferred and accepted gamma source compound based on ^{137}Cs. In spite of many desirable properties, CsCl has one disadvantage in that it undergoes solid-phase transformation at approximately 460°C, resulting in a sudden expansion in volume. Such a property presents problems in the design of capsules for the $^{137}CsCl$ source, because a sufficient volume must be allowed for expansion caused by the phase transformation. Since KCl may be one of the major impurities in $^{137}CsCl$, its effects on the phase behavior and other physical properties of CsCl were studied. The objectives and scope of the present investigation were: (1) to elucidate the complex behavior of the CsCl-KCl system in the solid-phase region with emphasis on the significance of disappearance of the differential thermal analysis (DTA) peaks for mixtures having low KCl contents, and (2) to prepare the phase diagram for the CsCl-KCl system based on data from different techniques including DTA, high-temperature x-ray diffraction, dilatometry, and high-temperature photomicrography. (TFD)

5868 TESTING OF SEALED RADIOACTIVE SOURCES FOR LEAKAGE. Ashton, T. (National Radiological Protection Board, Leeds, Eng.). Radiol. Prot. Bull.; No. 3, 9-12; 16(Apr 1973).

A brief outline discussion is presented in relation to leak testing of sealed radioactive sources. Passing reference is made to British requirements and recommendations concerning frequency and form of tests, radioactive and nonradioactive methods of leak testing and the recommendations of the International Standards Organization and the U. S. standards, and precautions to be taken while tests are being carried out. (UK)

5869 STUDY ON THE PREPARATION OF WOOD-PLASTIC COMBINATIONS. IV. Physical and Chemical Properties of Wood-Plastic Combinations. Kim, J.; Lee, K. H.; Pyun, H. C. (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 5: No. 1, 3-12 (Mar 1973).

Some physical and chemical properties of wood-plastic combinations(WPC) made of domestic soft woods such as pinus densiflora, pinus rigida, and poplus deltoides were measured. The rates of improvement in properties were roughly proportional to the contents of polymer or polymer mixtures in WPC. For the WPC obtained by means of radiation curing and containing 80% of polymer or polymer mixture, the hardness and water absorptivity were improved 2.2 and 4 times those of the original wood, respectively. The improvement of hardness was especially remarkable in the WPC made of pinus densiflora and polystyrene (120%) to show 7 times increased hardness. For the WPC obtained by means of thermal curing and containing 80% of polymer or polymer mixture, the hardness and water absorptivity were improved 2.4 and 3.4 times those of the nontreated woods, respectively. These data indicate that the properties of WPC prepared by means of radiation curing are not much different from those of WPC prepared by means of thermal curing. Both the acid and the alkali resistance of the WPC were also improved remarkably in comparison with nontreated wood. (auth)

5870 IN-SITU NEUTRON ACTIVATION. Wogman, N. A.; Perkins, R. W.; Rieck, H. G.; Cooper, J. A. (to United States Atomic Energy Commission). U. S. Patent 3,723,727. 27 Mar 1973. Filed date 30 Jun 1971. 4p.

A probe for in-situ neutron activation analysis that has a neutron source and a detector positioned in a fixed relationship is described. The material being analyzed is irradiated by the neutron source and then the detector is moved over the material for analysis. At all times the fixed relationship of the detector and the neutron source is maintained. The probe is particularly adapted for analysis of materials in inaccessible places such as the sea floor and includes a pressure plate for maintaining the material being analyzed in a fixed location during the analysis. (Official Gazette)

5871 DEPENDENCE OF NEUTRON SPECTRA FROM ISOTOPIC (α,n) SOURCES ON SEVERAL FACTORS. Trykov, L. A.; Tyufyakov, N. D. pp 3-10 of Prikladnaya Yadernaya Spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5872 SERVICES PROVIDED BY THE NATIONAL RADIOLOGICAL PROTECTION BOARD. Holliday, B. (National Radiological Protection Board, Harwell, Eng.). Radiol. Prot. Bull.; No. 3, 7-8(Apr 1973).

An outline note is made of the services provided by the Research and Development, Operations, and Administration Divisions of the U.K. National Radiological Protection Board, based on centres in Glasgow, Leeds, Harwell and Sutton. The Assessments Department of the Operations Division deals with problems posed by the presence of radiation sources in the public environment or in consumer goods, and with the assessment of the radiation dose to the UK population from all sources. There is also a Health Physics Measurement Group, whose program includes a survey of radon daughter products in British mines, and a Health Physics measurement group dealing with assessment and calibration of monitoring instruments. Other services include investigations of customer problems and training courses. (UK)

Design and Fabrication

Refer also to abstract 5433.

5873 APPROXIMATE CALCULATION OF SPECTRA OF BREMSSTRAHLUNG SOURCES. Kubicek, P. Jad. Energ.; 19: No. 5, 164-169(May 1973). (In Czech).

Theoretical analyses and sample calculations are presented for spectra of bremsstrahlung sources and their utilization. Approximate relationships for continuous spectra and the K_α characteristic radiation are examined, and attention is then turned to corrections to these relationships. The effect of some structural parameters of bremsstrahlung sources is examined in view of the knowledge that the choice of these parameters affects the form of the spectra as a function of their use. A theoretical analysis graphically shows the numerical calculations of the sources ^{147}Pm/Al, ^{147}Pm/Ag and some experimental results obtained with a single-channel gamma spectrometer. (tr-auth)

5874 PREPARATION OF NEUTRON SOURCES TO BE APPLIED IN INTERSTITIAL AND INTRACAVITARY RADIATION THERAPY. Bleyl, H. J.; Metzger, H. (Kernforschungszentrum, Karlsruhe, Ger.). (1972). vp. (In German).

From meeting: nuclear medicine and radiochemistry; Freiburg i. B., Germany (27 Sep 1972).

An important operation in the fabrication of ^{252}Cf neutron sources for interstitial and intracavitary radiation therapy is the welding of the source-supporting material into metallic casings. An induction-welding setup is described which guarantees both the adjustment required for such a small object (30 mm) and the necessary operating safety in remote handling. (GE)

5875 REPRODUCIBILITY OF THE METROLOGICAL CHARACTERISTICS OF THE UKPN-1 APPARATUS FOR CHECKING NEUTRON INSTRUMENTS. Yanovskii, A. P.; Fominykh, V. I.; Popruzhko, L. A. Meas. Tech. (USSR) (Engl. Transl.); 15: No. 11, 1701-1703(Nov 1972).

Translated from Izmer. Tekh.; 15: No. 11, 67-68(Nov 1972).

A collimated Po–Be neutron source facility for calibration of neutron detectors and dosemeters is described. (WHK)

5876 CESIUM-137 IRRADIATOR FOR SMALL LABORATORY ANIMALS. Hranitzky, E. B.; Almond, P. R.; Suit, H. D.; Moore, E. B. (Univ. of Texas, Houston). Radiology; 107: No. 3, 641-644(Jun 1973).

A ^{137}Cs internal irradiator for small animals is described. The irradiator is loaded with two opposing sources of 2,660 Ci each, yielding 1100 rads/min to a tightly-collimated 3-cm diameter field. The front faces of the sources are separated by 27 cm. Vertical uniformity of dose rate is ±1.4%; horizontal uniformity is ±4%. Leakage outside the defined beam is less than 1%. The absorbed dose rate is relatively independent of irradiated sample size. Dose rate to the skin is maintained at tumor dose rate. Beam alignment is accurately reproduced by a mechanical alignment pin. Irradiation time is controlled by an electronic logic package coupled to punched card reader. Provision is made for hyperbaric and anoxic treatment conditions. (auth)

Industrial Uses

Refer also to abstracts 5916, 5920–5922, 5936, 5937, 5962, and 6051.

5877 (BNWL-1308-13) PACIFIC NORTHWEST LABORATORY, ISOTOPE DEVELOPMENT PROGRAMS QUARTERLY REPORT: NOVEMBER 1972–JANUARY 1973. Jarrett, J. H. (comp.) Battelle Pacific Northwest Labs., Richland, Wash.). Mar 1973. Contract AT(45-1)-1830. 28p. Dep. NTIS $3.00.

The results of the radioisotope applications program activities and related research conducted during Nov. 1972 to Feb. 1973 are reported. The use of fission product xenon in the sputtering process was successfully demonstrated. No ^{85}Kr could be detected in a copper deposit thus prepared. The purification of fission product xenon for use in radiation detection equipment is continuing. The 1500-h tests on the high purity inert SrF_2 compatibility couples were completed and the couples are being evaluated. The feasibility of a medical isotope generator to provide ^{13}N for medical uses is being investigated. A device in which ^{13}N is generated via an α, n reactions with ^{10}B in an HBO_2 melt shows promise. Discussions with a leading transplant immunologist emphasized the need for a blood irradiator for immune suppression in transplants, and work continued on building irradiators fueled with ^{90}Sr–^{90}Y, ^{147}Pm, and ^{170}Tm. Noncirculatory heat exchangers were designed for abdominal implantation of $^{238}PuO_2$ sources in swine. Six source preparation runs were made with the new $^{241}AmO_2$ sputtering target. Excellent adherence both between the stainless steel substrate and sputtered americium oxide layer, and between the sputtered americium oxide layer and the sputtered platinum containment layer was demonstrated. Also, the sputtering equipment was operated continuously for 15 h with the need for only infrequent minor adjustments to maintain near steady-state conditions. Evaluation of nuclear techniques for seabed mineral exploration continued. Open ocean tests of the seabed mineral analyzer were successfully completed 5 km off Islamorada, Florida, in water depths to 15 m. These tests showed that all of the components of the seabed mineral analyzer work properly under actual ocean conditions. An additional detector, a 10.2 cm thick by 15.2 cm diameter sodium iodide crystal, was evaluated for its efficiency and resolution versus that of the Ge(Li) diode. The data taken in situ on some 13 elements and manganese nodules indicate that the detector of choice for any underwater survey must be based on the specific job being undertaken–for multiple element analysis, a Ge(Li) detector, and for high efficiency detection of a few noninterfering elements, a NaI(Tl). A study was completed which showed there were no significant fission product activity problems associated with segregated encapsulation of fuel-grade and non-fuel-grade ^{90}Sr in the Waste Encapsulation and Storage Facility (WESF). Two inert strontium fluoride (Hastelloy C-276) capsules were prepared for qualification testing. (LCL)

5878 STUDIES ON THE DIFFUSION AND MIXING OF SOLID PARTICLES IN A TUBE MIXER. 2. A New Practical Technique. Radwan, M. H. S.; Abdel-Hamid, A. A.; Hanna, S. B. (Cairo Univ.). Int. J. Appl. Radiat. Isotop.; 24: No. 4, 201-207(Apr 1973).

A radioactive tracer technique is proposed to follow the mixing operation in a tube mixer. It has been developed to overcome variations in particle distributions during the analysis of a mixture by other sampling techniques. A collimating system and scintillation detector is used to allow for the precise determination of the tracer in the different parts of the tube. The collimator is so designed that the tube can be rotated around its own axis and can be moved longitudinally so that any point along its axis can be brought exactly over the detector crystal. A scheme for testing the efficiency of the collimator is proposed, and data are presented from an experiment in which the whole equipment is used to follow the mixing of a bi-component system of which the particles of only one component are made radioactive by soaking in a dilute solution of a suitable isotope. (auth)

5879 STUDIES ON THE DIFFUSION AND MIXING OF SOLID PARTICLES IN A TUBE MIXER. 3. Theoretical and Practical Studies on the Efficiency of the Collimator. Radwan, M. H. S.; Abdel-Hamid, A. A.; Hanna, S. B. (Cairo Univ.). Int. J. Appl. Radiat. Isotop.; 24: No. 4, 209-212(Apr 1973).

Equations are derived for the theoretical count rates for a radioactive source in the mixer's tube at different positions with respect to the crystal of the scintillation probe, in terms of the geometry of the incorporated collimator. The corresponding experimental count rates are determined and the efficiency of the collimator obtained by comparing the theoretical and practical results. A χ^2-test of goodness of fit also shows the efficiency of the collimator. (auth)

5880 ISOTOPIC INVESTIGATION OF LIQUID FLOW IN INDUSTRIAL RECTIFICATION COLUMN. Graczyk, J. (Inst. of Nuclear Research, Warsaw). Nucleonika; 18: No. 1, 25-33 (1973). (In Polish).

Investigation of liquid flow in an industrial column for rectification of butadiene has been realized. The pulse method of introduction of radioactive tracer and radiometric analysis of tracer contents was used. The method of interpretation of the results was by a mathematical model of tanks in series. The usefulness of the isotopic method for determination of disturbance in liquid flow in rectification columns was demonstrated. (auth)

5881 TESTING CONTACTS BY MEANS OF RADIOISOTOPES UNDER DIFFICULT CLIMATIC CONDITIONS. Dekany, I. L. (Beloiannisz Plant, Budapest). Elektrie; 25: No. 8, 300-301 (1971). (In German).

Silver-110 was used as a tracer to measure the migration of material across communications equipment relay contacts under varying climatic conditions such as varying the H_2S and water content in the ambient atmosphere. The testing method is described. The results showed that the material migration across the contacts increased as a function of the number of switching cycles, that this increase was much more severe with operation at higher applied voltages and currents, and that the current-voltage effect exceeded the effects of the ambient climatic conditions. (LCL)

5882 USE OF IONIZING RADIATION FOR FOOD PRESERVATION. Basson, J. K. (Atomic Energy Board, Pelindaba, Pretoria, S. Afr.). Food Ind. S. Afr.; 23: No. 7, 23-26(Oct 1970). (In Afrikaans).

The physical principles of the use of ionizing radiation for the preservation of food are described, taking into consideration the widely available radiation sources as well as the necessary control measures for ensuring wholesomeness. Complete sterilization is limited by the resulting off-flavors and odors, but pasteurization as well as disinfestation appear as useful additions to existing food preservation methods. The present international situation is summarized, from which it appears that four countries have already given clearance for unlimited consumption of certain irradiated foods. It will be necessary for more countries to give such clearance before there can be a substantial international trade in such products, the most likely of which are believed to be potatoes, onions, grain and flour, fresh fish, chicken, canned hams, and sterilized meat products. Although food preservation by ionizing radiation has not reached an economically competitive stage, South Africa satisfies some of the pre-requisites for the useful application of radiation in food processing: first, a mature industrial economy and highly organized food distribution system and secondly, a large export trade in perishable commodities. In South Africa the only work of consequence has been carried out at the Research Institute for Fruit and Food Technology, Stellenbosch, where a 500 Ci ^{60}Co facility has been in operation since 1961—this will be increased to 5000 Ci in the near future; these investigations have concentrated on the irradiation of fresh fruit and vegetables. However, at the National Nuclear Research Center, Pelindaba, the Atomic Energy Board now has adequate facilities for irradiation studies, including an 18,000 Ci ^{60}Co facility (since June 1968) as well as the dry gamma facility at its SAFARI-1 research reactor, which makes use of spent fuel elements for irradiation purposes. (INIS)

5883 RADIOCHEMICAL PROCESSES FOR THE PROMOTION OF PROCESS TECHNIQUES IN THE TEXTILE INDUSTRY. Van Lancker, M. Textilis; 28: No. 7-8, 12-21(1972). (In Dutch).

In regard to the possibilities of using ionizing radiations in the textile industry, it is suggested that the beta rays produced by electron accelerators should be preferred to gamma sources, for example ^{60}Co, and that the cost of an electron accelerator could not constitute a check on future development. The use of synthetic resins is again a predominant factor for increase in costs. A minimal use of the monomer ought to be a major objective. (tr-auth)

5884 USE OF A FAST NEUTRON SOURCE FOR ACTIVATING SOLUTIONS BY NEUTRONS OF DIFFERENT ENERGY RANGES. Kartashev, E. R.; Markun, N. Yu.; Chulkin, V. L.; Shtan, A. S. pp 11-14 of Prikladnaya Yadernaya Spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

5885 RADIATION AND WOOD. Goto, T. (Shimane Univ., Matsue, Japan). Mokuzai Kogyo; 27: No. 5, 228-232(May 1972). (In Japanese).

The application of radiation to the measurement of wood quality of and the effects on the improvement or deterioration of the quality of wood were studied. Gamma radiation was used for measuring specific gravity, thickness and water content of the wood, and measurement of density of binding agents and thickness of binding layers, while β radiation was used for continuous automatic measurement of thickness of paper and single plates. Utilization of β radiation enables quicker measurement of wood density with less error. Most wood is decomposed by 3.3×10^8 rad β radiation, and decomposition of cellulose is conspicuous. Decomposition by γ radiation is weaker than by the β-rays. Gamma radiation has an influence on the rate of absorbing moisture and water, and makes the rate of swelling higher. Gamma-radiation affects mechanical properties as well. It also preserves the wood from decay to some extent due to its sterilizing effect. Though the influence of radiation on the wood quality would be an interesting subject for study, current investigations show that low dose irradiation improved material quality to some extent, but did not bring about essential improvement. Moreover, high dose radiation destroys cellulose chains which is basic component of the wood and decreases the strength of the wood. (HA)

5886 APPLICATION OF RADIOISOTOPES FOR THE ELIMINATION OF STATIC ELECTRICITY IN THE TEXTILE INDUSTRY. Luenenschloss, J.; Hess, V. (Technische Hochschule, Aachen). Melliand Textilber. Inst.; 53: No. 10, 1077-1080(1972). (In German).

A functional model for the origin, effect and elimination of the electrostatic charge during fabrication and treatment of textiles is developed and the principles underlying the charging process during the treatment of fabrics are given. An introduction into the generation of ionization fields and the subsequent elimination of charges by the application of natural and artificial radioisotopes is given. (GE)

5887 STUDIES ON THE DIFFUSION AND MIXING OF SOLID PARTICLES IN A TUBE MIXER. 5. Practical Studies on a Binary System with Two Radioactivated Components. Radwan, M. H. S.; Abdel-Hamid, A. A.; Hanna, S. B. (Cairo Univ.). Int. J. Appl. Radiat. Isotop.; 24: No. 6, 333-341(Jun 1973).

A program including 32 experiments was carried out to estimate the effects of six single factors and their interactions according to a half-replicated 2^6 factorial design. These factors are concerned with the container geometry, particle properties and mechanical speed applied to effect particle packing. The results obtained are statistically analysed and then discussed. (auth)

5888 ^{85}Kr LEAK TEST: AN IMPROVED DETECTION METHOD. Bruninx, E. (Philips Gloeilampenfabrieken NV, Eindhoven, Netherlands). Int. J. Appl. Radiat. Isotop.; 24: No. 6, 359-360(Jun 1973).

In normal ^{85}Kr leak testing of small sealed objects such as lamps the object is placed in a ^{85}Kr atmosphere and if a leak exists ^{85}Kr will penetrate the object. Faulty objects are then detected by means of NaI(Tl) well-type crystals by the γ-ray emission from leaked-in ^{85}Kr. Since ^{85}Kr decays only to the extent of 0.41% by γ-ray emission the method is not efficient and the background is quite high. It is thus suggested that the direct measurement of the emitted particles or the use of methods based upon the interaction of the β particles with the test object are more efficient methods of detection. The simplest method is to incorporate the test objects in a scintillating medium. The two cases whereby the wall thickness of the object is either smaller or larger than the range of the ^{85}Kr-emitted β particles are discussed. (UK)

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstracts 5352, 5912, 5916, and 6008.

5889 CHANGES OF ANTIGENICITY IN HUMAN SERUM ALBUMINS AFTER IRRADIATION. Miltenyi, L.; Vargha, G.; Dezsi, Z. (Radiological Clinic, Debrecen, Hungary). Strahlentherapie; 145: No. 1, 51-54(1973). (In German).

The changes of antigenicity in human albumins after irradiation were studied. The applied method of immunodiffusion is suitable for the demonstration of slight changes. The deviation increases in relation to the applied dose and yields results even if small doses are used. Under 100% oxygen, the irradiation effect on the dissolved human serum albumin is higher by one order of magnitude. (GE)

5890 RADIO-SENSITIZATION OF DNA TO THE DENATURATION EFFECT OF IRRADIATION CONDITIONS. Rebeyrotte, N. (Inst. of Radium, Paris). Int. J. Radiat. Biol.; 23: No. 3, 299-305(Mar 1973). (In French).

A study was made of the effect of denaturation on various x-irradiated DNA solutions, and compared with results obtained from DNA denatured before irradiation. A DNA transformation technique between two strains of Diplococcus pneumoniae was used as a method of assay. Results showed that denaturation treatment resulted in a greater inactivation of the transforming activity of already irradiated DNA, than that of native DNA. Survival curves are presented for irradiation of various buffered and unbuffered DNA solutions at 18°C over a dose range of 0 to 120 Krad, and at –75°C over a range of 0 to 5000 Krad. Similar experiments were carried out with tritium-labeled DNA for a strain of Escherichia coli and the formation of breaks in the polynucleotide chains followed by alkaline sedimentation techniques. In this case, in general if irradiation was carried out at –75°C, little difference was obtained between the effect of irradiation carried out on native or denatured DNA. (UK)

5891 REVIEW AND EVALUATION OF MOLECULAR WEIGHT CALCULATIONS FROM THE SEDIMENTATION PROFILES OF IRRADIATED DNA. Ehmann, U. K.; Lett, J. T. (Colorado State Univ., Fort Collins). Radiat. Res.; 54: No. 1, 152-162(Apr 1973).

The number-average molecular weight, M_n, of a random distribution of single-stranded DNA molecules can be calculated directly from the profile obtained after alkaline sucrose gradient sedimentation. For such a distribution, M_n can also be obtained from the weight-average molecular weight M_w, and the median molecular weight, $M_{½}$. When the size distributions are not random the latter procedures are erroneous. Nonrandom distributions of the type to be expected after irradiation of cellular DNA and its repair were generated by computer using Monte Carlo procedures. These distributions were then utilized as examples to illustrate the types of error that can be encountered when M_w and $M_{½}$ are used to calculate M_n from nonrandom distributions. (auth)

5892 RADIATION INDUCED STRAND BREAKAGE IN DNA FROM MAMMALIAN CELLS. Strand Separation in Alkaline Solution. Ahnstroem, G.; Erixon, K. (Univ. of Stockholm). Int. J. Radiat. Biol.; 23: No. 3, 285-289(Mar 1973).

Sedimentation experiments were made to study the completeness of DNA strand separation in alkali-treated cells (Chinese hamster (V79-379-A) and Microtus agretis). Cells containing tritium-labeled DNA were treated with alkali for 20 min and then neutralized. It was assumed that the DNA molecules in which the two strands had not separated completely could reversibly renature in neutral solution, whereas molecules in which strand separation was complete reassociated at a much slower rate. By keeping the concentration of DNA low, most of the DNA remained in a single stranded form and could be separated from the double stranded in a hydroxyl apatite column. Results showed that only a minor fraction of the DNA became single-stranded after treatment of unirradiated cells, this fraction increasing as a function of x-ray dose and being nearly complete at ~1 Krad. At this dose level and above, 15 to 20% of the DNA was still double stranded. Reassociation experiments indicated that these fractions consisted partly of DNA from more alkali resistant structures in the cell and partly of repetitive DNA, which had reassociated during hydroxyl apatite chromatography at 60°. It is suggested that 1 hit per 2×10^9 daltons would be required to cause a complete denaturation during 20 min of alkali treatment. (UK)

5893 EFFECTS OF γ-IRRADIATION ON THE STAINING OF GLYCOSAMINOGLYCANS WITH ALCIAN BLUE. Morgan, R. E. (Univ. of Alabama, Birmingham); Moore, J. S.; Phillips, G. O. J. Histochem. Cytochem.; 20: 831-832(Oct 1972).

Solutions were prepared of the following glycosaminoglycans: chondroitin-4-sulfate and chondroitin-6-sulfate from bovine trachea, dermatan sulfate from pig skin, keratan sulfate from bovine corena, and hyaluronic acid from rooster comb. The solutions were gamma-irradiated at a dose of 0.3 M rad. The irradiated solutions and unirradiated controls were applied to filter paper and stained for 1 hr with Alcian Blue. The critical electrolyte concentrations were reduced with progressive exposure to radiation. The significance of molecular weight, charge density, and depolymerization in producing this effect is discussed. (HLW)

5894 PURIFICATION, CHARACTERIZATION, AND X-IRRADIATION STUDIES OF NADH-DEHYDROGENASE FROM PHOTOBACTERIUM FISCHERI. Brendel, D. F. Ann Arbor, MI; Univ. of Michigan (1972). 119p. University Microfilms Order No. 73-11,050.

Thesis (Ph. D.).

Burns reported that bioluminescence of Photobacterium fischeri is depressed during irradiation both in vivo and in vitro. In cell-free extracts bioluminescence resulted from the coupled reactions of NADH-dehydrogenase (substrates NADH and FMN) and luciferase (substrates $FMNH_2$, oxygen, and aldehyde). Because this depression of bioluminescence is not a result of enzyme inactivation, it was postulated that the substrates or enzyme intermediates (enzyme-substrate complexes) were radiosensitive. NADH-dehydrogenase from P. fischeri was purified with a yield of 34% and a fold purification of 145. Oxidized NADH-dehydrogenase exhibited absorption maxima at 410 and 530 nm; the reduced enzyme had maxima at 423, 527, and 557 nm. The apparent molecular weight of NADH-dehydrogenase was 53,000. The NADH-dehydrogenase reaction was studied before, during, and after x irradiation. During irradiation, the increase in the enzymatic oxidation of NADH was due exclusively to the nonenzymatic oxidation of NADH. The enzymatic and nonenzymatic anaerobic reduction of FMN was also studied. Again x irradiation in the presence of the enzyme increased the reduction of FMN but only by the amount of the nonenzymatic reduction of FMN. In both instances the NADH-dehydrogenase activity was unaltered by irradiation; neither the apparent Michaelis-Menton constant, K_M, nor the apparent maximum velocity, V_{max}, of NADH-dehydrogenase were altered by irradiation. These results indicated that the nonenzymatic reactions of NADH and FMN are catalyzed by x irradiation. The NADH-dehydrogenase and luciferase reactions were coupled; luminescence was measured before, during, and after irradiation. Upon exposure to x irradiation, luminescence was depressed to 63% of initial luminescence; upon cessation of irradiation luminescence promptly recovered. These phenomena were observed in vivo and in vitro by Burns. Neither NADH-dehydrogenase or its enzyme-substrate complexes contributed to the depression of bioluminescence. Depression of luminescence must, therefore, result from the effects of radiation on the substrates or the enzyme-substrate complexes of the luciferase reaction. (Diss. Abstr. Int., B)

5895 EFFECT OF RADIATION ON ACTIVITY OF ANTIBIOTICS. Gupta, K. G.; Vyas, K. K.; Sekhon, N. S. (Panjab Univ., Chandigarh, India). J. Pharm. Sci.; 62: No. 5, 841-842(May 1973).

Thirteen antibiotics belonging to different groups were exposed to 5, 10, and 15 megarads of neutron and γ-radiations, and their activity in comparison to nonirradiated antibiotics for Escherichia coli and Staphylococcus aureus was studied. With γ irradiation, oxytetracycline at 15 megarads and penicillin G at 5 and 10 megarads showed considerable decrease in activity. With penicillin G, the activity was somewhat restored at the 15-megarad dose. Other antibiotics did not show a significant change in activity by this method. Neutron irradiation did not change the activity. (auth)

5896 KINETIC FORMALDEHYDE METHOD TO STUDY DNA IRRADIATED IN VITRO. Komolova, G. S.; Trifonov, E. N.; Egorov, I. A. (Inst. of Biochemistry, Moscow). Dokl. Akad. Nauk SSSR; 207: No. 1, 222-224(1 Nov 1972). (In Russian).

Defects in the secondary structure of DNA of thymus and spleen tissue of rats were induced by ^{60}Co-emitted γ radiation in vitro in 0.03 M NaCl solution. The despiralization rate of DNA increased under the action of formaldehyde and in proportion to the magnitude of the dose of γ-radiation. The concentration of defects in the secondary structure of rat DNA increased linearly with radiation dose, attaining one defect/2600 pairs of nucleotides with 5 kR of gamma. (KSW)

5897 INHIBITION OF PROTEIN SYNTHESIS IN EHRLICH ASCITES TUMOR CELLS BY IRRADIATION (365 nm) IN THE PRESENCE OF SKIN-PHOTOSENSITIZING FUROCOUMARINS. Bordin, F.; Baccichetti, F.; Bevilacqua, R.; Musajo, L. (Univ., Padua). Experientia; 29: No. 3, 272-273(15 Mar 1973).

Ehrlich ascites tumor cells were placed in solutions containing ^{14}C-amino acids and the furocoumarins, psoralen, xanthotoxin, and 8-methylporalen, and exposed to 365 nm ultraviolet radiation. At fixed times the radioactivity was determined using a liquid scintillation counting system. The tabulated results show that after irradiation in the presence of psoralen, the incorporation of labeled amino acids proceeded at a lower rate than that of controls. (HLW)

5898 SOME EFFECTS OF γ IRRADIATION ON DILUTE SOLUTIONS OF CHYMOTRYPSINOGEN. Lynn, K. R. (National Research Council of Canada, Ottawa). Int. J. Radiat. Biol.; 23: No. 3, 227-233(Mar 1973).

Chymotrypsinogen-A was γ-irradiated as a dilute solution. After tryptic digestion, a D_{37} of 7 krads was estimated for the produced δ-chymotrypsin. At this dose, approximately two tryptophan residues/molecule of chymotrypsinogen were destroyed. Thus the zymogen was shown to be more sensitive to irradiation than δ- and α-chymotrypsin. When irradiated chymotrypsinogen was fragmented, the two tryptophan residues/molecule affected at D_{37} were from the outer portion of the molecule. When irradiated α-chymotrypsin was similarly treated, four tryptophan residues per molecule were affected at D_{37}. The loss of two was measurable immediately after irradiation: two more were damaged in a manner only revealed during preparation for the tryptic fragmentation. (auth)

5899 FORMATION AND TRAPPING OF RADICAL PAIRS IN IRRADIATED THYMINE. Bergene, R.; Meloe, T. B. (Univ. of Oslo). Int. J. Radiat. Biol.; 23: No. 3, 263-270(Mar 1973).

Radical pairs were formed and stabilized in single crystals of thymine anhydrate when exposed to 4.0 MeV electrons at 77°K. The predominant pair was due to two cation radicals with interspin distance R = 6.76 Å. The activation energy for the decay of this particular pair was estimated to be 12.5 kcal/mole. (auth)

5900 RADIATION DAMAGE TO PROTEINS. An E.S.R. Study of a Single Crystal of Glycyl–Glycine at Low Temperatures. Meloe, T. B. (Univ. of Oslo). Int. J. Radiat. Biol.; 23: No. 3, 247-261(Mar 1973).

The electron paramagnetic spectra from a single crystal of glycyl–glycine were analyzed in the temperature range between 77° and 300°K, after the crystal was electron-irradiated at 77°K and then gradually heated. At 77°K, a decarboxylation product remains stabilized within the crystal lattice, as well as, most probably, the product of a deamination process. At about 140°K, the finally stable radical appears, although the decarboxylation product disappears, simultaneously. The finally stable radical is due to a hydrogen abstraction at the carbon-6 position. Two other radical species also arise, one of which is reported to originate from a hydrogen abstraction from the carbon-1 position, whereas the other is thought to stem from a fragmentation process at the peptide nitrogen. Both these radicals convert, upon further heating, into the finally stable radical. The entire spectrum also contains some other resonances, which are interpreted to originate from odd-δ-electron systems. (auth)

5901 E.P.R. OF FREE RADICALS FORMED IN DNA AND ITS CONSTITUENTS AFTER EXPOSURE TO DISCHARGE-EXCITED INERT GASES. I. Thymine and Thymidine. Weibezahn, K. F.; Dertinger, H. (Kernforschungszentrum, Karlsruhe, Ger.). Int. J. Radiat. Biol.; 23: No. 3, 271-277(Mar 1973).

Two different epr spectra were observed after bombardment of dry powders of thymine and thymidine with discharge-excited helium, argon, and nitrogen: the characteristic eight-line spectrum due to the C_6-adduct of atomic hydrogen to the base and a singlet interpreted as being formed by dissociation of the thymine C_6–H bond. The hydrogen atoms generated in this way are responsible for the adduct formation. (auth)

5902 FREE RADICALS INDUCED BY RADIOLYSIS OF FROZEN THYMIDINE-5′-MONOPHOSPHATE SOLUTIONS. Lion, Y.; Van de Vorst, A. (Univ., Liege). Int. J. Radiat. Biol.; 23: No. 3, 279-284(Mar 1973). (In French).

A brief note is presented of the results of an electron spin resonance study of frozen solutions of thymidine-5-monophosphate (TMP) x-irradiated at 77°K. Variations in spectra are presented, characteristic of acid, neutral, and alkaline solutions of TMP at 77° and 235°K. (UK)

5903 EFFECTS OF X-IRRADIATED HISTIDINE ON THE ATP CONTENT AND PROTEIN SYNTHESIS IN NUCLEI ISOLATED FROM THE RAT THYMUS. Shima, A. (Tokyo Univ.). J. Fac. Sci., Univ. Tokyo, Sect. IV; 12: No. 1, 59-73(1970).

The effects of x-irradiated histidine, presumably the hydroxyhydroperoxide of histidine, on nuclear metabolism were studied using isolated rat thymus nuclei and liver nuclei as material. The results are as follows: the ATP content and protein synthesis in isolated thymus nuclei were invariably reduced by incubation with irradiated histidine. The decrease in the ATP content of the thymus nuclei is not due to an accelerated hydrolysis of ATP, since it does not seem that nuclear ATPase is activated by either irradiated histidine or irradiated water. As regards the inhibition of nuclear protein synthesis, D_{50} was approx. 58 kR for irradiated histidine and approx. 127 kR for irradiated distilled water. These results indicate that a certain peroxide formed by the irradiation of histidine is actually playing a role in the inhibition of the nuclear metabolism of the thymus. By contrast, irradiated histidine did not affect the protein synthesis of isolated liver nuclei, indicating that there is a metabolic difference in radiosensitivity between the two tissues examined. (auth)

5904 INFLUENCE OF HEAT, RADIATION, AND ENZYMES ON PHYTOHEMAGGLUTININ. Kimura, T. (Tokyo Women's Coll.). Tokyo Joshi Ika Daigaku Zasshi; 42: No. 9, 672-683 (Sep 1972). (In Japanese).

Blastogenic and hemagglutinating activities of phytohemagglutinin were not affected by heating to 70°C for 30 min. The blastogenic activity was inactivated by radiation in doses of $40 \cdot 10^4$, while the hemagglutinating activity was not destroyed by doses of $80 \cdot 10^4$ rad. Blastogenic activity was not influenced by trypsin, α-chymotrypsin, peptidase, or phosphodiesterase. These results suggested that hemagglutinin could be obtained free from blastogen. (HLW)

Radiation Effects on Cells

Refer also to abstract 5892.

5905 (BNWL-SA-4667) MODELS FOR INACTIVATION BETWEEN HITS. Roesch, W. C. (Battelle Pacific Northwest Labs., Richland, Wash.). 2 Apr 1973. Contract AT(45-1)-1830. 8p. (CONF-730431-1). Dep. NTIS $3.00.

From annual meeting of the Radiation Research Society; St. Louis, Missouri, USA (29 Apr 1973).

In the development of time-dependent hit theory of radioinduced inactivation of animal cells a specific assumption was made about how the probability of surviving the combined effects of two hits varied with the time between them. It was assumed that the time dependence was exponential; the probability for surviving two hits was taken to be $S_1^2(1 - ae^{-bt})$ where a and b are constants, t is the time between the hits, and S_1 is the probability of surviving each hit individually when the time between them is so great that there is no influence of one on the other. Simple models of time-dependent behavior, on the other hand, predict multiple-exponential functions of the form $C_0 + C_1e^{-b_1t} + C_2e^{-b_2t} + \ldots + C_ne^{-b_nt}$ for the survival. The present paper shows that, for physically reasonable values of the parameters in the models, the terms in the series of the second equation are negligible and that, therefore, the first equation is a good approximation for use in hit theory. (auth)

5906 EXCISION REPAIR (DIMER EXCISION, STRAND BREAKAGE, AND REPAIR REPLICATION) IN PRIMARY CULTURES OF EUKARYOTIC (BOVINE) CELLS. Cleaver, J. E. (Univ. of California, San Francisco); Thomas, G. H.; Trosko, J. E.; Lett, J. T. Exp. Cell Res.; 74: No. 1, 67-80(Sep 1972).

Excision repair of ultraviolet radiation damage to DNA in primary cultures of eukaryotic (bovine) cells can be demonstrated by the formation of DNA strand breaks after irradiation, excision of cyclobutyl pyrimidine dimers, and repair replication. Rapidly after irradiation (within 5 min) a steady state is established in which the number of strand breaks (8000/cell at 100 ergs/mm^2) and the rate at which bases are inserted by repair replication reach a constant level that is then maintained for several hours. Thereafter the number of strand breaks and the rate of repair replication diminish and 75 to 80% of the dimers are excised in 24 h. On the basis of the close correlation of the kinetics of the various aspects of excision repair, it is suggested that repair is effected by complexes of repair enzymes, each of which performs all steps of excision repair. Such complexes would insert between 70 and 140 bromouracil or thymine bases for each excised photoproduct and spend about 20 min for location of a photoproduct and completion of a repair region. Hydroxyurea did not interfere with rejoining of the strand breaks. Chloroquine, in contrast to reports in E. coli, had no specific effect on excision repair. Immediately after irradiation, cells exposed to high pH and a chelating agent (EDTA) lyse to release DNA more rapidly than control cells. This accelerated release, which may be the consequence of DNA strand breaks or UV damage to membranes and proteins, is lost by about 3 h after irradiation, suggestive of a recovery process distinct from excision repair. (auth)

5907 THEOPHYLLINE-INDUCED TRANSLOCATION OF CALCIUM IN THE PANCREATIC BETA CELL: INHIBITION BY DEUTERIUM OXIDE. Malaisse, W. J. (Univ., Brussels). Nature (London) New Biol.; 242: No. 119, 189-190(11 Apr 1973).

The rate of insulin release by the pancreas is thought to be regulated by the concentration of calcium in the cytosol of the beta cell. A study was made of the effect of D_2O upon calcium metabolism in the pancreate β cell, observations being made of the influence of heavy water upon the theophylline induced outflow of ^{45}Ca from isolated perfused islets of Langerhans. In the absence of D_2O, the addition of theophylline to the perfusate produced an immediate and sustained increase in the flow of ^{45}Ca from the isolated islets. When all the H_2O was replaced by D_2O, the addition of theophylline to the perfusate did not cause any obvious alteration in the progressive decrease of ^{45}Ca flow, but only partial inhibition was observed when the perfusion was performed in the presence of glucose. It is suggested that either the D_2O directly inhibits the translocation of calcium from the vacuolar system, or the heavy water might prevent the accumulation of adenosine-3′, 5′-cyclic monophosphate, which is thought to mediate the effect of theophylline on calcium distribution in the β cell. (UK)

5908 MAMMALIAN CELL CULTURE STUDIES. Bootsma, D. (Dept. of Cell Biology and Genetics, Rotterdam); Keijzer, W.; Kleijer, W. J.; de Weerd-Kasterlein, E. A.; de Wit, J.; Meera Khan, P.; Someren, H. V.; Westerveld, A. Genetics, Suppl.; 73: 167-179(Apr 1973).

Complementation experiments have been performed to study the genetic basis of hypoxanthine-guanine phosphoribosyltransferase (HGPRT) deficiency in cells being resistant to the base analog 8-azaguanine. The hybrid binucleated cells obtained in fusion experiments with HGPRT-deficient cells of different origin were not able to incorporate ^3H-hypoxanthine, indicating the absence of complementation in all the fusions that were carried out. The application of cell hybridization in the study of gene linkage and gene localization is illustrated with studies on man-Chinese hamster somatic cell hybrids. Little progress has been made in relating mutation rates to DNA repair processes in mammalian cells. One mutation in DNA repair in man, the genetic skin disease xeroderma pigmentosum (XP), is described. Genetic heterogeneity in XP was demonstrated by complementation experiments, indicating the presence of at least three different complementation groups. The biochemical studies performed thus far suggest that these xeroderma cells are defective in one of the first steps in the excision of uv photoproducts. (HLW)

5909 INTERFERON INDUCTION BY RHINOVIRUSES AND EFFECT OF INTERFERON ON RHINOVIRUS YIELDS IN HUMAN CELL LINES. Stoker, D.; Kiernat, J.; Gauntt, C. (Arizona Medical Center, Tucson). Proc. Soc. Exp. Biol. Med.; 143: No. 1, 23-27(May 1973).

Rhinovirus serotypes 13, 14, and 20 did not induce detectable levels of interferon in HeLa, KB, or L-132 cells following challenge with infectious, uv-inactivated, or heat-inactivated virus preparations. HeLa cell cultures incubated with interferon prior to challenge with the three rhinovirus serotypes also failed to produce interferon. No resistance to VSV plaque formation was induced in HeLa cell cultures previously challenged with uv- or heat-inactivated lysates of the three rhinovirus serotypes. Replication of the three rhinovirus serotypes in HeLa cell cultures was inhibited by the action of interferon with an order of sensitivity being RV13 < RV14 < RV20. (auth)

5910 CHARACTERISTICS OF DNA SYNTHESIS FOLLOWING ULTRAVIOLET LIGHT IRRADIATION IN MOUSE L CELLS. Postreplication repair. Fujiwara, Y. (Kobe Univ., Japan). Exp. Cell Res.; 75: 483-489(Dec 1972).

Mouse L cells partially synchronized as to DNA synthesis were tested for ability to bypass uv-induced DNA photoproducts during postirradiation DNA synthesis. The amount of ^3H-thymidine incorporated into the DNA of irradiated cells indicates that dimers remaining unexcised in the DNA, block DNA synthesis, though not permanently. Alkaline sucrose sedimentation has revealed that daughter DNA newly synthesized for 2 h in irradiated cells is discontinuous due to a gap presumably opposite each dimer in parental DNA. Such smaller daughter strands exhibit a dose-dependent reduction in the rate of sedimentation and differ from normally replicating short segments. Taking into account the replication rate reduced by uv irradiation, these gaps in daughter DNA seem to be almost closed by the time the synthesis of the involved DNA units is completed, as the sedimentation rate of daughter DNA approaches that of parental DNA during the subsequent chase incubation of irradiated cells. These results provide evidence for the bypass of photoproducts remaining unexcised in DNA, by which mouse L cells may recover. (auth)

5911 REPAIR OF DAMAGED DNA IN THE ABSENCE OF PROTEIN SYNTHESIS IN MAMMALIAN CELLS. Gautschi, J. R.; Young, B. R.; Cleaver, J. E. (Univ. of California, San Francisco). Exp. Cell Res., 76: 87-94(Jan 1973).

Inhibition of protein synthesis in HeLa S3 and CHO cells by cycloheximide rapidly reduces semiconservative DNA replication, but repair replication of DNA damaged by ultraviolet light or x rays is unaffected by cycloheximide for up to 8 h and is only slightly reduced (35%) by 20 h. These results indicate that repair replication does not require concomitant protein synthesis, and the enzymes involved in such repair appear to have long lifetimes in the cell. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 5939 and 6005.

5912 (COO-3095-10) ULTRAVIOLET LIGHT EFFECTS ON NUCLEIC ACID FORMATION AND GENETIC EVENTS IN BACTERIA. Three Year Comprehensive Report. Doudney, C. O. (Albert Einstein Medical Center, Philadelphia, PA. Dept. of Genetics). Apr 1973. Contract AT(11-1)-3095. 42p. Dep. NTIS $4.25.

Progress is reported on the following research projects: ultraviolet effects on DNA replication; effects of chloramphenicol on DNA replication in ultraviolet-damaged Escherichia coli; chloramphenicol-promoted DNA degradation in ultraviolet-damaged Escherichia coli; RNA involvement in DNA replication in ultraviolet-damaged bacteria; loss of photoreversibility of damage to DNA replication and of lethal damage in ultraviolet-irradiated bacteria; preirradiation inhibition of protein synthesis and increased ultraviolet resistance; and ultraviolet-induced mutation. (HLW)

5913 (NP-tr-1944) USE OF X-RAYS TO ATTENUATE THEILERIA ANNULATA, DSCHUNKOWSKY ET LUHS 1904. Barannikov, V. D.; Abramov, I. V. Translated by M. Prazak (Australian Atomic Energy Commission Research Establishment, Lucas Heights Tr. Vses. Inst. Eksp. Vet.; 38: 73-77(1970)). 7p. Dep. NTIS (U.S. Sales Only) $3.00.

X rays at doses of 15,000 and 10,000 R inactivated the causative agent of bovine theileriosis in the leucocytic-cellular suspensions from the lymph nodes and internal organs of animals with theileriosis. To determine the effectiveness of irradiated organisms for use as vaccines, suspensions of irradiated organisms were administered to young bovines. No effect on immunity of the animals to theileriosis was found. (HLW)

5914 (ORO-3408-20) PROGRESS REPORT ON PHYSICOCHEMICAL STUDIES OF RADIATION EFFECTS IN CELLS. Powers, E. L. (Texas Univ., Austin. Lab. of Radiation Biology). 14 May 1973. Contract AT(40-1)-3408. 14p. Dep. NTIS $3.00.

Progress is reported on the following research projects: dose rate effects of ultraviolet radiation on bacterial spores; effects of ultraviolet radiation on germination of spores; radiation effects on photosynthesis in Chlorella; radiation chemistry of cellular inactivation; effects of N_2O on dried spores; inert gas effects; and water uptake by spores. (HLW)

5915 (SU-326-P-34-2) IONIZING RADIATION AS A HOSPITAL STERILIZING AND DISINFECTING AGENT. Final Report. Gonda, T. A.; Harder, T. J.; Strom, E. C.; Donnelly, M. E.; Carpenter, T. M. Jr. (Stanford Univ., Calif. (USA). Medical Center). 28 Feb 1973. Contract AT(04-3)-326. 95p. Dep. NTIS $6.75.

A survey was made to determine how Stanford University Hospital might apply irradiation as a method of reducing nosocomial infections. The sources of information used were current literature, previous hospital studies, current data, specially conducted surveys, and interviews with hospital personnel. The first section is a graphic model which relates the process of eliminating active pathogens from a surface to the likelihood of contracting an infection. The second section compares the pros and cons of current disinfecting and sterilizing procedures with those of irradiation. These two sections give the basis for selecting 19 different items or groups of items to review as possible candidates for sterilization using ionizing radiation. Each item discussed is classified as to the estimated research effort needed to resolve its candidacy and the spatial proximity of its use in relationship to the patient. It was concluded that the development of ionizing radiation as a hospital sterilizing and disinfecting agent is a valid objective. (30 references) (CH)

5916 CURRENT STATUS AND PROSPECTS OF APPLICATION OF IONIZING RADIATION IN FOOD PRESERVATION. Uralova, M.; Grunt, J. (Vyskumy Ustav Hygieny, Bratislava). Prum. Potravin; 23: No. 9, 272-274(Sep 1972). (In Slovak).

The situation is briefly reviewed of the application in various countries of ionizing radiation in the preservation of food. An outline is presented of experiments aimed at investigating the effect of gamma radiation on vitamin F in vitro and in biological material. Alpha tocopherol was used as a biological model. A destructive effect of gamma radiation was found on the vitamin; the radiolysis of the vitamin was not only affected by the dose but also by the concentration of the vitamin. The dose rate was found to be indirectly proportionate to the destruction. A significant effect was also observed of the medium in which the vitamin was kept during irradiation. (INIS)

5917 DECREASE IN SURVIVAL OF UV-IRRADIATED BACTERIOPHAGE T1 BY UV-IRRADIATION OF ESCHERICHIA COLI B HOST. Mosin, A. F.; Petrova, K. M.; Tsib, T. S. (Inst. of Medical Radiology, Obninsk, USSR). Int. J. Radiat. Biol.; 23: No. 3, 291-293(Mar 1973).

Evidence is presented that competitive inhibition of phage DNA repair by uv-damage in the host DNA does not explain the decreased survival of uv-irradiated phage resulting from uv irradiation of host bacteria. Irradiated or unirradiated Escherichia coli cells were incubated in the presence or absence of chloramphenicol or cyanide. When these cultures were infected with unirradiated bacteriophage T1, its viability was affected neither by irradiation of hosts nor by their incubation in the presence of chloramphenicol. On incubation of the irradiated cells before pre-adsorption of phage, the survival of phage gradually increased, and after 45 min of incubation, the effect of after irradiation of hosts on the survival of uv-exposed phage, disappeared. It is pointed out that although the survival of phage pre-adsorbed to irradiated cells, after their incubation in the presence of chloramphenicol, had the same effect as on the cells infected immediately after irradiation, the recovery processes are not affected by that compound. However incubation of uv-exposed cells with cyanide, a strong inhibitor of recovery, resulted in some reduction of the effect of cell irradiation on the phage viability. (UK)

5918 CHEMICAL RADIOSENSITIZATION AT THE CELLULAR LEVEL WITH HALOGENATED IMIDAZOLIDINES. Alvarez, M. V.; Astudillo, M. D.; Bolanos, F.; Ramos, E.; Sanz, F. (Instituto de Quimica Fisica Radiobiologia, Madrid). Arch. Inst. Farmacol. Exp. (Madrid); 21: No. 1-2, 101-105(1969). (In Spanish).

The radiosensitizing effects of the halogenated imidazolidines: (A) 3-(o-chlorophenyl)-1,2-dihydro-6-hydroxy-5-(1,2-dihydroxyethyl)-3H-furo[2,3-d]imidazole-2-thione; (B) 3-(3,4-dichlorophenyl)-1,2-dihydro-6-hydroxy-5-(1,2-dihydroxyethyl)-3H-furo[2,3-d]imidazole-2-thione; and (C) 3-(p-bromophenyl)-1,2-dihydro-6-hydroxy-5-(1,2-dihydroxyethyl)-3H-furo[2,3-d]-imidazole-2-thione were studied in Saccharomyces cerevisiae. The cells were radiosensitized with (A) but not with (B) and (C). None of the preparations were toxic. (ERB)

5919 RELATIVE BIOLOGICAL EFFECTIVENESS OF NEUTRONS FOR PROPHAGE INDUCTION. Hussain, S.; Ehrenberg, L.; Ahnstroem, G. (Univ. of Stockholm). Int. J. Radiat. Biol.; 23: No. 3, 307-309(Mar 1973).

A brief note is made of the results of a study of the RBE of neutron irradiation in the range of maximum energies of 0.25 to 2.7 MeV using prophage induction in an Escherichia coli-bacteriophage system as a means of assay. Results are presented for γ irradiation doses over a range 0 to 1500 rads, and for neutron doses over the range 0 to 600 rads. Neutrons in the range of maximum energies 0.25 to 2.7 MeV exhibited approximately the same effectiveness for prophage induction, 4.9 (±S.E. 0.3)% per Krad, and almost the same value, 4.6 (±S.E. 0.2)% per Krad was obtained for ^{60}Co radiation. A value of 1 was obtained for the RBE (1.06 ± 0.16, 95% confidence interval). (UK)

5920 EFFECTS OF GAMMA IRRADIATION ON SOME PROPERTIES OF TWO AEROMONAS PROTEINASES. Dahle, H. K.; Underdal, B. (Veterinary Coll. of Norway, Oslo). Acta Vet. Scand.; 13: 492-504(1972).

The proteinases A and B of Aeromonas liquefaciens and proteinase B of Aeromonas salmonicida were, in the crude and purified state, exposed to various doses of γ radiation from a ^{60}Co source, and the D_{37} values indicate that the proteinase A is the most resistant. Casein was shown to have a marked protective effect on both proteinases during the irradiation, and while solutions of the purified enzymes were inactivated by doses usually used for food pasteurization, the crude enzymes, or solutions of purified enzymes to which casein was added, required doses usually used for food sterilization before being inactivated. Only minor effects of the environmental pH were observed. The antigenic properties of the enzymes seemed to be qualitatively unchanged in solutions exposed to 150 krads as observed using the casein precipitation inhibition test, and the irradiated proteinases were also inhibited by the naturally occurring proteinase inhibitors in the immune sera. The enzymoserological properties were not influenced by the changes in electrophoretic migration demonstrated by the zymogram technique. These proteinases are suitable as models for the examination of the physical properties of food-spoiling enzymes and also for taxonomical work. (auth)

5921 IRRADIATION OF CHOCOLATE AND CHOCOLATE PRODUCTS. Gruenewald, T. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Z. Lebensm.-Untersuch. Forsch.; 151: No. 1, 13-17(1973). (In German).

Irradiation of chocolate products for disinfestation is particularly applicable to filled chocolate creams. The sensitivity of the chocolate coating does however limit the irradiation dose to about 30 krads. Pure chocolate, according to the proportion of chocolate and milk is much more sensitive and a dose as low as 3 krad can affect the organoleptic quality. For pure chocolate with a high content of cocoa, an effective irradiation dose for disinfestation is in many cases accompanied by a decrease in quality. In most cases irradiation with a dose higher than 7.5 krad cannot be recommended. (GE)

5922 REDUCTION OF SPOILAGE LOSSES OF STRAWBERRIES BY IONIZING RADIATION. Farkas, J.; Kiss, I.; Bencze, J. Acta Aliment.; 13: No. 2, 203-213(1972).

Two series of experiments were carried out with the strawberry variety Senga sengana. In the first series the fruit was irradiated in batches of 0.5 kg and in the second in 0.2 kg batches and stored at 12 to 14°C and 22 to 24°C respectively. A ^{60}Co panoramic gamma radiation source of 50 kCi activity was used at a dose rate of about 200 krad/hr. The results of the experiments show that the loss due to spoilage during the 3 to 7-day periods between harvesting and marketing was reduced by treatment with 200 to 300 krad gamma radiation to one-half to one-fourth of the loss in the untreated control sample. It is not advisable to use radiation doses above 300 krad because of the hazard of softening of the fruit and of reduced resistance to microorganisms. A decrease in the sensory quality as established by triangular test was not observed even in strawberry samples treated with 400 krad. The packaging materials and methods applied at present in the storage and transport of strawberries can be used for radurization as well. (auth)

5923 EFFECT OF THYMINE STARVATION ON DEOXYRIBONUCLEIC ACID REPAIR SYSTEMS OF ESCHERICHIA COLI K-12. Anderson, J. A.; Barbour, S. D. (Case Western Reserve Univ., Cleveland). J. Bacteriol.; 113: No. 1, 114-121(Jan 1973).

Thymine starvation of Escherichia coli K-12 results in greatly increased sensitivity to ultraviolet light (uv). Studies, using isogenic strains carrying rec and uvr mutations, have shown the following. Common to all strains tested is a change from multi-hit to single-hit kinetics of survival to uv after 60 min of thymine starvation. However, the limiting slope of uv survival curves decreases in the rec$^+$ uvr$^+$ strain and changes very little in several rec mutant strains and one uvrB mutant strain. Thus, when either the rec or uvr system is functioning alone, the limiting slopes of the uv survival curves are relatively unaffected by thymine starvation. Thymine starvation does not significantly inhibit repair processes carried out by either repair system alone; i.e., host cell reactivation of irradiated phage (carried out by the uvr system), excision of thymine dimers (uvr), or x-ray repair (rec). In a rec$^+$ uvr$^+$ strain, repair appears to be a synergistic rather than additive function of the two systems. However, after thymine starvation, repair capacity is reduced to about the sum of the repair capacities of the independent systems. The kinetics of thymineless death are not changed by rec and uvr mutations. This indicates that the lesions responsible for thymineless death are not repaired by rec or uvr systems. Withholding thymine from thy rec$^+$ uvr$^+$ bacteria not undergoing thymineless death has no effect on uv sensitivity. Under these conditions one sees higher than normal uv resistance in the presence or absence of thymine. This is due to increased repair carried out by the uvr system. To explain these results it is postulated that thymine starvation does not inhibit either the rec or uvr repair pathway directly. Rather it appears that thymine starvation results in increased uv sensitivity in part by inhibiting a function that normally carries out efficient coordination of rec and uvr pathways. (auth)

5924 RADIATION-RESISTANT MUTANTS OF SALMONELLA TYPHIMURIUM LT2: DEVELOPMENT AND CHARACTERIZATION. Davies, R.; Sinskey, A. J. (Massachusetts Inst. of Tech., Cambridge). J. Bacteriol.; 113: No. 1, 133-144(Jan 1973).

A series of repeated exposures to gamma irradiation with intervening outgrowth of survivors was used to develop radioresistant cultures of Salmonella typhimurium LT2. Stepwise increases in resistance to both ionizing and ultraviolet irradiation were obtained independently of the presence or absence of integrated P22 prophage. Single clonal isolates, representing parent and radioresistant populations, retained the general characteristics of the LT2 parent, including serological properties, phage typing, antibiotic sensitivities, mouse virulence, and most biochemical test reactions. Resistant cells were generally larger and contained 1.8 to 2.1 times more ribonucleic acid and protein than parent cells, but deoxyribonucleic acid (DNA) contents were similar. Heterogeneity in the populations with respect to release of H_2S, utilization of carbon sources, and growth on minimal medium is considered to be ancillary, rather than causally related, to increased radioresistance. The resistant isolates displayed an increased ability to reactivate gamma-irradiated P22 phage. DNA polymerase I and polynucleotide-joining enzyme activities were elevated in extracts of radioresistant cells relative to parent cells. It is suggested that the observed increases in radioresistance result from a selection of mutations leading to an increased capacity to repair DNA. (auth)

5925 ULTRAVIOLET-SENSITIVE MUTATOR STRAIN OF ESCHERICHIA COLI K-12. Siegel, E. C. (Tufts Univ., Medford, MA). J. Bacteriol.; 113: No. 1, 145-160(Jan 1973).

An ultraviolet (uv)-sensitive mutator gene, mutU, was identified in Escherichia coli K-12. The mutation mutU4 is very close to uvrD, between metE and ilv, on the E. coli chromosome. It was recessive as a mutator and as a uv-sensitive mutation. The frequency of reversion of trpA46 on an F episome was increased by mutU4 on the chromosome. The mutator gene did not increase mutation frequencies in virulent phages or in lytically grown phage λ. The mutU4 mutation predominantly induced transitional base changes. Mutator strains were normal for recombination and host-cell reactivation of uv-irradiated phage T1. They were normally resistant to methyl methanesulfonate and were slightly more sensitive to gamma irradiation than Mut^+ strains. UV irradiation induced mutations in a mutU4 strain, and phage λ was uv-inducible. Double mutants containing mutU4 and recA, B, or C were extremely sensitive to uv irradiation; a mutU4 uvrA6 double mutant was only slightly more sensitive than a uvrA6 strain. The mutU4 uvrA6 and mutU4 recA, B, or C double mutants had mutation rates similar to that of a mutU4 strain. Two uv-sensitive mutators, mut-9 and mut-10, isolated by Liberfarb and Bryson in E. coli B/uv, were found to be co-transducible with ilv in the same general region as mutU4. (auth)

5926 ULTRAVIOLET-SENSITIVE MUTATOR mutU4 OF ESCHERICHIA COLI INVIABLE WITH polA. Siegel, E. C. (Tufts Univ., Medford, MA). J. Bacteriol.; 113: No. 1, 161-166(Jan 1973).

Attempts to transduce the ultraviolet-sensitive mutator lesion mutU4 into strains deficient in deoxyribonucleic acid polymerase I (polA) were unsuccessful. Mutator recombinants were found when the polA recipient had first been reverted to Pol^+ by selection for resistance to methyl methanesulfonate. The inviability of the mutU4 polA double mutant was demonstrated by a reduction in the absolute number of transductants when the recipient was polA as compared with Pol^+, and selection was made for markers very close to mutU4. Double mutants containing mutU4 and polA4, which determines a cold-sensitive polymerase, were unable to grow at 24 C, the nonpermissive temperature. (auth)

5927 GENETIC ANALYSIS OF REPAIR OF ULTRAVIOLET DAMAGE BY COMPETENT AND NONCOMPETENT CELLS OF BACILLUS SUBTILIS. Hadden, C. T.; Billen, D. (Univ. of Florida, Gainesville). J. Bacteriol.; 113: No. 1, 88-95(Jan 1973).

The repair of ultraviolet (uv) damage in Bacillus subtilis $W23T^-$ was studied by transformation with deoxyribonucleic acid (DNA) extracted from irradiated cells before and after repair. The extent of repair of genetic markers by donor cells after low or moderate doses of UV was found to be related only to the initial degree of inactivation. After a very high dose, further inactivation occurred, also in proportion to initial damage. In addition, the competent recipient cells were shown to repair approximately 75% of the damage in transforming DNA. The sensitivities of markers irradiated either in vivo or in vitro appeared to be related to map position, the more proximal markers showing a greater resistance to uv inactivation. (auth)

5928 THYMINELESS DEATH AND ULTRAVIOLET SENSITIVITY IN MICROCOCCUS RADIODURANS. Little, J. G.; Hanawalt, P. C. (Stanford Univ., CA). J. Bacteriol.; 113: No. 1, 233-240(Jan 1973).

Thymine-requiring mutants of Micrococcus radiodurans were isolated by selection on solid medium containing trimethoprim. Strains requiring either high concentrations of thymine (50 μg/ml) or low concentrations (2 μg/ml) for normal growth were obtained. The Thy^- mutant requiring low thymine concentrations has been characterized. It was shown to retain the high ultraviolet light (uv) resistance typical of wild-type M. radiodurans, but it was not resistant to thymineless death. Preliminary exposure of the cells to thymineless conditions resulted in enhanced uv sensitivity, and this interaction occurred under conditions where unbalanced growth was inhibited by the addition of chloramphenicol. Upon addition of thymine to deprived cells, uv resistance was gradually restored, and this recovery took place in the absence of protein synthesis. A model is proposed to account for the similarity of thymineless death in bacteria whose deoxyribonucleic acid repair efficiencies differ widely. (auth)

5929 GENES CONTROLLING ULTRAVIOLET MUTABILITY IN YEAST. Lemontt, J. F. (National Research Council of Canada, Ottawa). Genetics, Suppl.; 73: 153-159(Apr 1973).

A review is presented of studies on genetic control of ultraviolet-induced mutagenesis in Saccharomyces cerevisiae. The following topics are discussed: selection and characterization of rev mutants; influence of rev on forward mutation induction; and selection of mutants for defective uv-induced forward mutation. (HLW)

5930 GENETIC AND PHYSIOLOGICAL SEPARATION OF THE REPAIR AND MUTAGENIC FUNCTIONS OF THE exrA GENE IN ESCHERICHIA COLI. Bridges, B. A. (Univ. of Sussex, Brighton, Eng.). Genetics, Suppl.; 73: 123-129(Apr 1973).

The $exrA^+$ gene in Escherichia coli has at least two functions that can be distinguished by both genetic and physiological means: One is involved in facilitating the $recA^+$-dependent repair pathway, while the other promotes an error-prone step in this pathway. Certain strains have been found to suppress the repair but not the mutagenesis deficiency of the exrA allele, as evidenced by both survival and alkaline sucrose gradient sedimentation data following gamma irradiation. Furthermore, the repair deficiency is suppressed by incubation with 200 μg/ml chloramphenicol added 90 min before gamma irradiation and present for 60 min afterwards; this result also argues that neither protein synthesis nor normal DNA replication is required for this type of repair. The error-proneness of "recombination" repair in several Uvr^- strains of E. coli K-12 after ultraviolet radiation appears to be increased by the presence of a small amount of nutrient broth in the plating medium. One interpretation of this effect is that the mutagenic function of the $exrA^+$ gene is affected. (auth)

5931 ULTRAVIOLET MUTAGENESIS IN polA AND uvrA polA DERIVATIVES IN ESCHERICHIA COLI B/R; EVIDENCE FOR AN INDUCIBLE ERROR-PRONE REPAIR SYSTEM. Witkin, E. M.; George, D. L. (Rutgers—The State Univ., New Brunswick, NJ). Genetics, Suppl.; 73: 91-108(Apr 1973).

UV-induced mutations occur with the same frequency per survivor, at most uv doses, in polA and $polA^+$ strains, whether the strains compared are both Uvr^+ or both Uvr^-. Mutations believed to originate through misrepair of gaps left in the DNA by excision of pyrimidine dimers, as well as those originating in daughter-strand gaps opposite unexcised pyrimidine dimers, are equally frequent among polA and $polA^+$ survivors. We conclude that the cause of uv sensitivity in polA strains is not abortive excision repair. Our data suggest that all excision gaps in polA strains are ultimately closed, although the rate of repair synthesis may be very slow. To explain the uv sensitivity and normal uv mutability of polA strains, we propose that error-prone post-replication repair (or one or more of its components) is inducible, with the same genetic and physiological requirements for induction as other uv-inducible functions such as induction of prophage lambda and uv reactivation of irradiated bacteriophage. We suggest that the slow rate of excision gap repair in polA cells causes them to induce all of the functions only at the low doses characteristic of Uvr^- strains, and that the cause of death in polA at higher uv doses is failure to induce the repair system in active form. The high uv mutability at very low doses that is predicted by this hypothesis for polA strains is actually observed. The uv sensitivity of a uvrA polA double mutant is the same as that of its uvrA $polA^+$ parent if the plating medium contains no nutrient broth. Addition of nutrient broth to the post-irradiation plating medium increases the uv sensitivity of the double mutant more than that of its uvrA $PolA^+$ parent, suggesting that DNA polymerase I plays a part, in Uvr^- strains, in minimizing the uv-sensitizing effect of complex media. (auth)

5932 LETHAL SECTORING IN YEAST. James, A. P. (National Research Council of Canada, Ottawa). Genetics, Suppl.; 73: 165-166(Apr 1973).

A brief discussion is presented of radioinduced lethal sectoring in yeast. It is pointed out that although the damage is hereditary, the affected cells are subject to continual recovery. Other topics discussed are: genetic analysis of unstable lines; the problem of post-irradiation multi-step recovery; characteristics of meiotic reversion; and segregation of the adenine locus. (HLW)

5933 LIQUID-HOLDING AND RECOVERY FROM UV-INDUCED DAMAGE IN EUDORINA ELEGANS. Kemp. C. L. (Simon Fraser Univ., Burnaby, British Columbia). Arch. Mikrobiol.; 86: No. 3, 255-264(1972).

Eudorina elegans does not respond to liquid-holding or to post-irradiation medium effects by changes in recovery. A decrease in survival ability is observed if a culture is starved prior to irradiation, or is incubated at 22°C rather than 32°C following uv irradiation. Eudorina loses the ability to photoreactivate uv damage within 14 to 48 hr following irradiation, depending upon the pre- and post-uv culture conditions. The results are interpreted as indicating a failure of Eudorina elegans to carry out specific dark repair of uv damage. Some reactivation may occur during cellular DNA synthesis. (GE)

5934 LET AS A DETERMINANT OF OXYGEN ENHANCEMENT RATIO AND SHAPE OF SURVIVAL CURVE FOR CHLAMYDOMONAS. Bryant, P. E. (Medical Research Council, London). Int. J. Radiat. Biol.; 23: No. 3, 217-226(Mar 1973).

Survival curves for Chlamydomonas were obtained for radiations having different values of LET α or stopping power. Irradiations were performed under either aerobic or anoxic conditions. Survival curves changed mostly in respect of extrapolation number or shoulder width, as LET was increased, the final slope remaining almost constant. The mode of variation in oxygen enhancement ratio (o.e.r.) was strikingly similar to the pattern of variation in D_Q as LET was increased. A straight line relationship was shown to exist between D_Q value and o.e.r. when these values were computed for the same experiments at different values of LET α. (auth)

5935 MECHANISM OF CHEMICAL RADIOSENSITIZATION. Kada, T. (National Inst. of Genetics, Mishima, Japan). Gan No Rinsho; 18: No. 9, 600-604(Sep 1972). (In Japanese).

Studies of chemical radiosensitization have been developed during the past 10 yrs. The paper reviews the current aspect of studies on radiosensitization and types of sensitizers with reference to literature. Chemical radiosensitizers known at present are mostly those effective on microorganisms. The first type of radiosensitizers is those that accelerate the injury (or fixation) of the target cell, in which there is one group activated after being incorporated into DNA and the other activated with irradiation or with adjunction. The second type is those that accelerate cell killing indirectly by destroying the element that has the ability for protection or recovery from the radiation injuries of the target cell. For example, NEM, IAA (iodoacetamide), and HMB (p-Hydroxymercuribenzoate) have been known as effective radiosensitizers impeding enzyme activity reacting with SH radicals that must be involved with the repair function of the cell. It is also well known that such iodine compounds as IA, IAA, and NEM were effective radiosensitizers, however, these compounds show also high toxicity. It is therefore suggested that halogenides might be useful as radiosensitizers without being incorporated into DNA. (Japan)

5936 EFFECT OF GAMMA RADIATION ON PRERIGOR MORTIS FILLETED COD. Jebsen, J. W. (Fiskeridirektoratets Kjemisk-Teknisk Forskningsinstitutt, Bergen); Lunde, G.; Underdal, B. Fiskeridir. Skr., Ser. Teknol. Unders.; 5: No. 11, 14p. (1972).

The effect of gamma radiation on cod fillets was studied. Cod caught off the west coast of Norway were immediately filleted after slaying, packed in plastic bags and irradiated at the Institutt for Atomenergi, Kjeller. The doses were 25, 50, 90, and 180 krad. Irradiated and nonirradiated fillets were stored at 0°C and analyzed at intervals with respect to proteolytic activity, total bacterial count, trimethylamine (TMA), total volatile base (TVB), volatile acids (VA), hypoxanthine, and glutamate-oxalacetate-transaminase (GOT). In irradiated cod fillets the proteolytic activity was considerably lower than in nonirradiated fillets. The proteolytic activity is correlated with the bacterial count, which was significantly decreased by irradiation. Correspondingly, TMA, TVB, VA, and hypoxanthine formation were retarded by irradiation. The GOT concentration was lower in irradiated fillets than in nonirradiated. During the first days after irradiation, a crab-like odor could be registered in fillets receiving 90 and 180 krad. This special odor disappeared gradually and irradiated fillets were found to be organoleptically acceptable after 27 days storage at 0°C, compared to 14 days for nonirradiated fillets. (auth)

5937 GAMMA RADIATION IN THE EXTENSION OF SHELF-LIFE OF APPLES INFECTED WITH ASPERGILLUS NIGER VAN TIEGHEM. Roy, M. K.; Chatrath, M. S.; Mukewar, P. M. (Indian Agricultural Research Inst., New Delhi). Phytopathol. Z.; 75: No. 1, 31-37(1972).

Aspergillus niger grew very slowly at 20°C. Of the temperatures tried best growth was obtained at 33 to 34°C. The progress of rot on apples was very slow at 20°C. The conidia of the fungus showed poor germination at 20°C. These spores had a high glucose content but had low sucrose and arabinose contents. Only 55 to 60% of conidia germinated in 2.0 percent sucrose solution at 32 to 33°C. On irradiation the germination of the conidia was depressed considerably at a dose of 100 Krad and this effect was increased with progressive increase in the dose of irradiation. The percentage of irradiated spores capable of growing and forming colonies was much less than those able to germinate. Twenty-four-hour-old mycelia grew slowly after irradiation at 100 krad. Depending on the varieties of apples, these fruits could be stored for 5 to 7 days at 20°C with a dose of 150 to 200 krad without any visible injury to the fruits. (GE)

Radiation Effects on Plants

Refer also to abstracts 5914, 5937, and 6005.

5938 (BNWL-SA-4531) LETHAL AND MUTAGENIC RESPONSES OF CHLAMYDOMONAS REINHARDI TO 1.55 MeV PROTON IRRADIATION. Braby, L. A.; Nachtwey, D. S. (Battelle Pacific Northwest Labs., Richland, Wash.; Oregon State Univ., Corvallis. Dept. of General Science). 1973. Contract AT(45-1)-1830. 14p. (CONF-730431-2). Dep. NTIS $3.00.

From annual meeting of the Radiation Research Society; St. Louis, Missouri, USA (29 Apr 1973).

Chlamydomonas reinhardi, synchronized by a 12 hour light–12 hour dark regime, were irradiated on agar at approximately the 9th hour of the cell cycle with 1.55-MeV protons. Survival was determined by counting live and dead cells with a microscope and also by comparing photographs (20X magnification) taken shortly after plating and at daily intervals up to four days after irradiation. Survival curves obtained in this way show a pronounced shoulder, which suggests that proton irradiation inactivates by multiple energy-deposition events. Furthermore, at the LD50, 5000 rads, the fluence is 15.7 protons per $(\mu m)^2$, and the cross-sectional area of the nucleus at the time of irradiation is approximately 3 $(\mu m)^2$. If the whole nucleus is the target these data are consistent with multiple-hit inactivation. The RBE at the LD50 level, relative to 300 kVp x rays, is about 2. Preliminary split-dose experiments suggest that a portion of the shoulder in the survival curve may be attributable to a cellular repair system. The mutation frequency appears to be higher than that obtained with x rays at comparable survival levels. (CH)

5939 (ORO-2690-13) ANNUAL REPORT NO. 13, September 1, 1972–August 31, 1973. Part B. Technical. (Florida State Univ., Tallahassee. Inst. of Molecular Biophysics). 1 Jun 1973. Contract AT(40-1)-2690. 65p. Dep. NTIS $5.25.

Progress is reported in the following areas of research: mechanism of action and evolution of enzymes; the biological toxicity of intracellular radioisotope decay by beta emission and electron capture; biophysical chemistry of nucleoproteins and mechanism of infection of viruses; use of 7-azaindole as a molecular probe for photoautomerism; physicochemical mechanisms underlying muscular contraction; molecular genetics of bacteria and bacteriophages; theory of electronic spectral properties of molecular states; physical properties of chromatin and model nucleoproteins; physiological mechanisms of color vision and of dark adaptation; microdosimetry for the analysis of the cytotoxic effects of incorporated radioisotopes; organizational and structural properties of chromosomal DNA related to genetic regulation of replication and repair of DNA damaged by chemicals or radiation; physical methods in radiation biology; photochemical aspects of visual processes; and organization of chromosomal DNA in eukaryotes. (HLW)

5940 (RLO-2221-T-2-16) INCREASING THE EFFECTIVENESS, EFFICIENCY, AND SPECIFICITY OF MUTATION INDUCTION IN FLOWERING PLANTS. Nilan, R. A. (Washington State Univ., Pullman. Dept. of Agronomy and Soils). 1972. Contract AT(45-1)-2221. 35p. Dep. NTIS $3.75.

A literature review is presented of recent research on the effectiveness, efficiency, and specificity of chemical and physical mutagens. Chemical mutagens are reviewed with regard to factors influencing their effectiveness and efficiency such as solubility and concentration of the mutagen, duration of the mutagen treatment, temperature and hydrogen ion concentration of the treatment solution, and stage of the chromosome cycle at which treatment is applied. The effectiveness and efficiency of ionizing radiations are reviewed with emphasis on gamma rays, x rays, and fast neutrons. Research on methods of increasing the effectiveness and efficiency of useful or beneficial mutations in crop plants is discussed. Mutagenic specificity is discussed and studies on mutagens that react selectively with certain genes are reviewed. Sieves, or chemical changes that a mutagen may undergo before reaching the gene, are discussed in relation to mutagenic specificity. (~100 references) (HLW)

5941 (RLO-2221-T-2-20) STUDY OF FACTORS GOVERNING PLANT RADIOSENSITIVITY. Annual Progress Report, May 1, 1972–May 1, 1973. Nilan, R. A.; Konzak, C. F. (Washington State Univ., Pullman). 1 May 1973. Contract AT(45-1)-2221. 5p. Dep. NTIS $3.00.

Progress is reported on the following research projects; effects of sodium azide on frequency of chromosome aberrations in barley seeds; combined effects of sodium azide, DES, and MNH on mutation frequencies in barley; synergistic effects of caffeine and irradiation on frequencies of chromosome aberrations; analysis of DNA from irradiated and nonirradiated barley seeds; effect of peroxidase in mediating radiation damage; and effects of x radiation on control and ethylene-treated leaves. (HLW)

5942 (RT/BIO-(72)20) BEHAVIOR AND TRANSMISSIBILITY OF RADIATION-INDUCED RING CHROMOSOMES. Saccardo, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 16 Sep 1970. 16p. (In Italian). (CONF-700458-2). Dep. NTIS (U. S. Sales Only) $3.00.

From 14th conference of Italian Agricultural Genetics Society; Parma, Italy (1 Apr 1970).

Following x radiation (750 R) of pollen of Pisum cv. Parvus, variegated and chlorina maculata mutants were isolated in the M3 generation. The mutants were characterized by the presence of ring chromosomes that were persistent and transmissible through male gametes as shown by a back cross analysis. As a result of chromosome behavior at mitotic anaphase, cells with different genomes were formed. A chimeric structure with a mosaic phenotypic pattern was found in the mutant plants. A higher percentage of cells with ring chromosomes and double bridges was found in the variegated mutant. In both mutants a high percentage of anaphase I with lagging ring chromosomes and a low percentage of chromatid bridges were found. In progenies of variegated plants with 2n = 14 + 1 ring, normal, variegated, trisomics, and partial tetrasomics were identified. (HLW)

5943 REGULATION OF PATHOGENICITY OF UV RADIATION-INDUCED AMINO ACID DEFICIENT MUTANTS OF FUSARIUM UDUM ASSOCIATED WITH WILT OF CAJANUS CAJAN (L) MILLSP. Purkayastha, R. P.; Das, A. (Univ. of Calcutta). Indian J. Exp. Biol.; 10: No. 6, 442-444(Nov 1972).

Survival percentage of conidia as well as percentage of amino acid deficient mutants were determined in a strain (FU13) of F. udum subjected to uv radiation (2537 Å). Out of 8 isolated stable mutants, the growth response of 2 including a methionine/cysteine/cystine deficient mutant (M60$_2$) and a methionineless mutant (M60$_7$) were studied in vitro. Concentrations of methionine, cysteine, and cystine required for optimal growth of M60$_2$ were 1.0, 0.1, and 1.0 mg/ml, respectively. M60$_7$ strain also exhibited optimal growth in 0.1% methionine. Supplement of appropriate concentrations of the required amino acids with the inocula partially restored the pathogenicity of test mutants. An extraneous supply of either methionine or complete medium to the mutants or complete medium alone to FU13 caused more wilting than the other added amino acids. Methionine appeared to have a significant role in pathogenesis. (auth)

5944 CYTOGENETIC EFFECT OF THERMAL NEUTRONS IN LENS ESCULENTA (MOENCH). Uhlik, J. (Univ. of Agriculture, Prague). Biol. Plant. (Prague); 14: No. 2, 97-102(1972).

Cytogenetic effects of thermal neutrons in Lens esculenta (MOENCH) lentil are considered. The range was also determined of cytologic effect-producing doses, which made it possible to compare the cytologic and the mutagenic effects of thermal neutrons on the plant and to study their effect on the growth and the development of the M$_1$ generation plants. Exposure to thermal neutrons was found to show cytologic effects on all characteristics studied. In most characteristics, linear dependence of the effect on an increased dose of irradiation was found. Following doses of 3.3×10^{11} n·cm^{-2} to 4.5×10^{12} n·cm^{-2}, chromosomal bridges and fragments were found in 9.0 to 72.0% of the total number of the investigated cells whose nuclei had been in anaphase or early telophase. The total number of recombinations per one cell reached a maximum value of 2.16 following a dose of 4.25×10^{12} n·cm^{-2}. (NSA of Czechoslovakia)

5945 EFFECTS OF MITOMYCIN-C ON ROOT MERISTEM CELLS OF VICIA FABA L. Part II. Induced Chromosomal Aberrations in Relation to Cell Cycle. Shah, V. C.; Rao, S. R. V.; Arora, O. P. (Univ. of Delhi). Indian J. Exp. Biol.; 10: No. 6, 431-435(Nov 1972).

Effects of mitomycin-C on partially synchronized root meristem of V. faba were studied to gain information regarding the stage of cell cycle when chromosomes are susceptible to breakage, and pattern and distribution of aberrations induced by mitomycin as compared to those induced by x rays. Autoradiographic studies revealed that the chromosomal aberrations were confined only to the labeled cells, suggesting that mitomycin action is confined to the DNA synthetic period (S phase). Quantitative studies on the aberration yield in the synchronized seedlings exposed to mitomycin at different stages of the interphase after 5-AU treatment revealed that the cells exposed during early or middle S phase carried low frequency of abnormal chromosomes. A high incidence of aberrations was induced in late S phase after synchronization. Analysis of chromosomal aberrations in synchronized roots revealed that 93.5% of chromosomal breaks were localized in the heterochromatic segments, the large metacentric chromosome breaking more frequently than the short chromosomes, and the percentage of abnormal metaphases scored at different intervals after mitomycin treatment in synchronized roots followed a cyclic pattern closely related to the cell cycle. High incidence of chromosomal aberrations were obtained when mitomycin treatment was followed or preceded by x-irradiation. The probable mechanism of action of mitomycin in producing localized chromosomal aberrations in the heterochromatic segments is discussed. (auth)

5946 RADIATION DAMAGE TO BIOLOGICAL MATERIALS IN THE DRY STATE. Yamaguchi, H. (Tokyo Univ.). Proc. Jap. Conf. Radioisotop.; No. 10, 431-433(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

The effect of the water content in seeds on radiation damage to the seeds, an after effect of seed irradiation called storage effect, the effect of oxygen and SH compounds in treatment after irradiation, the heat treatment effect before and after irradiation, the configuration analysis of ESR spectra for two types of radical, and thermoluminescence analysis are reviewed generally. The effect of cysteine treatment of irradiated seeds of the rice plant on its survival rate and mutation and the relation of oxygen treatment and SH treatment for barley seeds containing 9% of water before and during irradiation were investigated. It is conceivable on the basis of the experimental results that the radicals produced in the irradiated seeds promote radiation damage when coupled with oxygen molecules, and that the SH compounds promote recovery from the radiation damage by acting on the radicals and do not act on substances produced from the reaction of the radicals with the oxygen. According to the experiment on gamma irradiation of seeds in liquid nitrogen to measure the thermoluminescence during temperature rise, the dependence of the attenuation coefficient, λ_1, on exposure and dose rate showed that there exists some attenuating component in the irradiated seeds even at the temperature of liquid nitrogen. Further, it is conceivable that the radiation damage to the seeds in the dry state can be explained on the basis of the promotion of radical movement by reaction of the radicals with the oxygen and reaction between the radicals. (Japan)

5947 MODIFICATION BY MEANS OF AN ANTIBIOTIC OF THE EFFECT OF ^{60}Co GAMMA RADIATION AT THE CHROMOSOMAL LEVEL. Moutschen, J.; Gilot-Delhalle, J.; Thakare, R. G. (Univ., Liege). Kerntechnik; 15: No. 2, 72-74(1973). (In German).

Nigella damascena seeds were treated with 0.5 mg/l and with 1.0 mg/l solution of the antibiotic bleomycin A$_2$ either for 8 hrs followed by drying to the original moisture content or for 15 hrs without subsequent drying. Both series were then subjected to ^{60}Co gamma irradiation at absorbed dose levels from 1 to 10 krad for the dry seeds and from 100 to 1,000 rad for the soaked seeds. In the dry seeds series, bleomycin at a concentration of 1.0 mg/l potentiated the effects of the irradiation at all dose levels, whereas at a concentration of 0.5 mg/l it potentiated these effects at doses of 6 krad and over. With soaked seeds, the potentiation was more pronounced than with the dry seeds. The effects observed included all types of chromosomal aberrations without, however, any changes in the relative proportions of the various types. The potentiation may possibly be explained by an indirect mechanism of action of bleomycin. (GE)

5948 RADIOPROTECTING ACTION OF CYSTEAMINE ON THE GROWTH OF ^{60}Co IRRADIATED RICE SEEDS (ORYZA SATIVA L CIGALON VARIETY). Soler, A.; Ravelomanana, D.; Bayonove, J. (Univ., Montpellier, France). Compt. Rend., Ser. D; 275: No. 25, 2989-2992(18 Dec 1972). (In French).

The immersion of rice seeds in a 0.1 per 1000 cysteamine solution prior to irradiation with ^{60}Co significantly increases the number of surviving plantules and accelerates their growth rates. An enhanced radioresistance is obtained by immersion in water followed by drying of the grains before exposure to irradiation. (France)

5949 STUDIES ON CITRUS CAROTENOIDS. 5. Effect of Cathode Ray Irradiation on the Carotenoid Pattern of Citrus Peel and on the Incorporation of 2-^{14}C Mevalonic Acid into Carotenoids.

Umeda, K.; Kawashima, K. (Food Research Inst., Tokyo). Nippon Shokuhin Kogyo Gakkaishi; 18: No. 12, 557-562(Dec 1971). (In Japanese).

Japanese oranges (Citrus Unshiu) were irradiated by electron beams and the change of carotenoid pattern was investigated. The total carotenoid content of 2.5 Mrad irradiated peel was reduced to about 60% but gradually increased in parallel with the unirradiated control. At a dose of 12.5 Mrad, more than eight days were required to restore the carotenoid content. The change of carotenoid pattern after the irradiation was almost the same in the samples exposed to 2.5 Mrad and 12.5 Mrad. Decreases of diol diepoxide and monol monoepoxide carotenoids, increase of diol, diol monoepoxide, and polyol carotenoids; and little change of hydrocarbon and monol carotenoids were observed. 2-^{14}C MVA was absorbed from vascular bundles of oranges. The effects of irradiation on the synthesis of ^{14}C-carotenoid from 2-^{14}C MVA was investigated. (auth)

5950 STIMULATION OF DIFFERENTIATION IN ORANGE (CITRUS SINENSIS) OVULAR CALLUS IN RELATION TO IRRADIATION OF THE MEDIA. Spiegel-Roy, P.; Kochba, J. (National and Univ. Inst. of Agriculture, Rehovoth, Israel). Radiat. Bot.; 13: No. 2, 97-103(Apr 1973).

Gamma irradiation of ovular callus of Shamouti orange (Citrus sinensis) caused a marked stimulation in embryoid formation at a dose of 16 kR. Doses of 28 to 32 kR proved lethal. Irradiation may cause a shift from conditions favorable for callus growth to those favoring embryoid formation. Irradiation of the medium, containing malt extract, caused as much embryoid stimulation as did irradiation of callus and medium. In media containing adenine, irradiation of the medium, containing malt extract, caused as much embryoid stimulation as did irradiation of callus and medium. In media containing adenine, irradiation led to cessation of both callus growth and embryoid formation. With low kinetin and indole-acetic acid (IAA), irradiation depressed callus growth and stimulated embryoid differentiaion. (auth)

5951 RADIOSENSITIVITY OF SHAMOUTI ORANGE (CITRUS SINENSIS) SEEDS AND BUDS. Spiegel-Roy, P.; Padova, R. (National and Univ. Inst. of Agriculture, Rehovoth, Israel). Radiat. Bot.; 13: No. 2, 105-110(Apr 1973).

Seeds, budwood, and plants of the orange cv. Shamouti were irradiated with a ^{60}Co gamma source. The LD_{50} for seeds was between 8 and 10 kR, with 12.5 kR being 90% lethal. Peeled seed germinated earlier, but showed no differences in radiosensitivity. Some stimulation of germination rate and early growth with low doses was found, but the effect was inconsistent and in most cases temporary. Buds from shoots originating on plants irradiated with 4 to 8 kR, did not sprout as well as the control, when budded to rootstocks. Buds from shoots irradiated after being detached from the tree, had a LD_{50} below kR, with few buds surviving the 7.5 kR dose. No appreciable differences in radiosensitivity between the buds of nucellar and "old clone" origin were noted. (auth)

5952 RADIATION-INDUCED TUMOROUS OUTGROWTHS IN YOUNG GAMETOPHYTES OF OSMUNDA REGALIS. Haigh, M. V.; Howard, A. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Radiat. Bot.; 13: No. 2, 111-119(Apr 1973).

When prothalli of Osmunda regalis were irradiated 21 days after spore germination, abnormal outgrowths were observed one week or more later. Some outgrowths developed into normally-growing new prothalli; others formed tumors of limited growth. The frequency of appearance of each type was dependent on radiation dose. When 300 kVp x rays were compared with 14 MeV neutrons, the RBE for tumor production was in the range 2.5 to 5. For spore killing in the same material the RBE was 5.2 at high doses. The OER was also essentially the same for the two endpoints, i.e, about 2.5 for tumor induction and 2.3 for cell killing. It is suggested that the radiation effect primarily responsible for tumor production is cell death and/or mitotic arrest. (auth)

5953 GAMMA IRRADIATION INDUCED VARIABILITY IN PHASEOLUS VULGARIS L. CV. BLUE LAKE. Mujeeb, K. A.; Greig, J. K. (Kansas State Univ., Manhattan). Radiat. Bot.; 13: No. 2, 121-126(Apr 1973).

Acute gamma irradiation effects on Phaseolus vulgaris L. cv. Blue Lake resulted in selection of four macromutants in the M_2 generation, designated SDM-1 and SDM-2 (semi-dwarfs), LfHy (late flowering/high yielding), and PSHy (pod shape/high yielding). The mutants were tested for characteristic stability until the M_4 generation. SDM-1 and SDM-2 were determinate, short, trailing, with foliage variability. Both germinated, bloomed, and matured later than the parent Blue Lake (control). The SDM's exhibited minus mutations for number of pods, 100-seed weight and yield, all significantly different ($P > 0.05$) from the control. LfHy had plus mutations for number of pods, seeds, and yield, but by a minus mutation for 100-seed weight. The delayed flowering presumably resulted from an early profuse plant growth; the increased plant height, as a secondary response to delayed flowering. PSHy had flattened pods and oval seeds, significantly greater yield potential with more pods and seeds than the parent. Its 100-seed weight did not differ significantly from that of the control. The yield data for all four macromutants were significantly influenced by number of pods, apparently the primary factor regarding yield. Protein contents of all macromutants were similar to that of the control. Hence, the nutrition aspect does not impede advancement of these lines. (auth)

5954 EFFECTS OF GAMMA IRRADIATION ON GROWTH AND YIELD OF AGRICULTURAL CROPS. 3. Root Crops, Legumes, and Grasses. Davies, C. R. (Agricultural Research Council, Wantage, Eng.). Radiat. Bot.; 13: No. 2, 127-136(Apr 1973).

The effects of acute γ irradiation on growth and yield were studied in potato, sugar beet, pea, broad bean, white clover, perennial ryegrass, and meadow fescue. The sensitivity of these plants to irradiation differed considerably both between species and depending on the stages of growth at which they were irradiated. For example, early in the life-cycle of potato and sugar beet exposure to 4 krads reduced yield by 50%, whereas in older plants twice this dose was required to induce the same effect. In broad bean, the most sensitive crop so far examined, yields were reduced to half when 0.1 to 0.25 krad was delivered at the time of flowering or 0.25 to 0.50 krad at earlier vegatative stages; the sensitivity of pea was lower by a factor of about two. In clover and grasses, there was little difference in sensitivity between seedlings 3 or 7 weeks old; for the former crop 16 krads reduced yield by 50% or more whereas less than 8 krads was required for similar reductions of yield in perennial ryegrass and meadow fescue. (auth)

5955 EFFECTS OF GAMMA IRRADIATION ON GROWTH AND YIELD OF AGRICULTURAL CROPS. 4. Effects on Yields of the Second Generation in Cereals and Potato. Davies, C. R.; Mackay, D. B. (Agricultural Research Council, Wantage, Eng.). Radiat. Bot.; 13: No. 2, 137-144(Apr 1973).

The effects of irradiating wheat, barley, and potato plants with acute gamma radiation on the yield of a second generation crop was examined. The viability of cereal grain was little affected when the parent plants were exposed to radiation during early vegetative stages, but irradiation after anthesis greatly affected the subsequent crop. The yields of wheat and barley were respectively reduced by about 50% and over 80% when the parent plants had received 2 krads late in the life cycle. The irradiation of potato plants with 4 krads when tubers were forming reduced the yield of the second generation by about 50%; 8 krads completely inhibited sprouting. (auth)

5956 EFFECTS OF METABOLIC INHIBITORS ON GIANT CELL FORMATION IN OEDOGONIUM CARDIACUM. Banerjee, S. N.; Horsley, R. J. (Ontario Cancer Treatment and Research Foundation, Hamilton). Radiat. Res.; 54: No. 1, 121-129(Apr 1973).

Synchronously growing sporelings of Oedogonium cardiacum treated with colcemide (500 μg/ml) form giant cells in their progeny that are morphologically similar to those induced by x- or uv-irradiation. The yield of giant cells in the progeny increases as the time of exposure to colcemide is lengthened and a maximum yield is observed for cells treated up to 20 hr. Cycloheximide given during the colcemide exposure prevents giant cell formation and concomitantly increases cell survival. The yield of giant cells from x- or uv-irradiated cells is not changed by postirradiation treatment with FUdR. On the other hand, the yield of giant cells is decreased by actinomycin D treatment after exposure of G_2 cells to high doses of radiation, but cell survival is not altered appreciably. In contrast, the treatment of G_2-irradiated cells with cycloheximide prevents giant cell formation and consequently increases cell survival. These results imply that the radioinduced lethal damage in G_2 cells as manifested by giant cell formation is similar to the giant cells induced by long exposure to colcemide and may, primarily have been caused by the synthesis of incomplete or faulty proteins. (auth)

5957 LETHAL DAMAGE AFTER X- AND UV-IRRADIATION AND ITS MODIFICATION BY HYPOXIA AND CYCLOHEXIMIDE. Horsley, R. J.; Banertee, S. N.; Laszlo, A.; Parker, K. (Ontario Cancer Treatment and Research Foundation, Hamilton). Radiat. Res.; 54: No. 1, 110-120(Apr 1973).

The results of further investigations on giant cell formation after x-irradiation under hypoxia and oxygenated conditions and after uv-irradiation are presented. The maximum yield of giant cells in the progeny from G_2 cells x-irradiated in the presence of N_2 in the dark or in the presence of O_2 in the light is about the same with the exception that the peak value for cells irradiated in N_2 occurs at a higher dose than that for cells irradiated in O_2. This difference in dose at the peak values may be reconciled on the basis of equivalent loss of cellular reproductive ability. Similar to the results after x-irradiation, giant cell formation is a maximum in the progeny for G_2 cells irradiated with uv. Cycloheximide treatment after x-ray and uv-irradiation of G_2 populations inhibits giant cell formation while at the same time percentage of survival increases at all the dose levels studied. It is postulated that giant cells are formed due to abnormal protein synthesis, presumably, due to malformed microtubules in the cell wall. Cycloheximide treatment after an insult through radiation prevents this expression of potentially lethal radiation damage by inhibiting radioinduced abnormal protein synthesis. (auth)

5958 RADIATSIONNYI MUTAGENEZ I MODIFITSIRUYUSHCHIE EGO USLOVIYA. (Radioinduced Mutagenesis and Modifications of Its Conditions). Orav, T.; Shangin Berezovskii, G.; Orav, I. Tallin; Izdatel'stvo Valgus (1972). 216p.

Radiosensitivity of plants, genetic causes, and physiologic factors contributing to the radiosensitivity of seed introduce the topic of mutagenesis. Attention is then focussed on the conditions that affect the germination and growing of irradiated seed and thereby the genetic outcome of the radiation: temperature, oxygen, seed preservation, humidification regime, the time of sowing, nitrogen addition, and postradiation treatment of the seed with chemical agents (e.g., sulfates of divalent metals). The effects of biologically active substances on the processes of mutagenesis, ethyleneimine, N-nitrosoethylurea, 1,4-bis-diazoacetylbutane, etc., with and without radiation, and the effect of latent variability are examined. A closing chapter deals with the use of radioinduced mutagenesis in selection work. Approximately 450 references. (KSW)

5959 METHOD OF RADIOAUTOGRAPHY IN STUDYING KINETICS OF MERISTEM CELLULAR CYCLES OF HIGHER PLANTS DURING γ-IRRADIATION. Gudkov, I. N.; Grodzinskii, D. M.; Grupina, S. A. (Inst. of Plant Physiology, Kiev). Fiziol. Biokhim. Kul't. Rast.; 3: No. 2, 115-121(1971). (In Russian).

Autoradiography and ^{3}H-thymidine were used in studies on the effects of gamma radiation on meristem cell cycles in horse bean and pea seedlings. In the root meristem of unirradiated horse bean plants the duration of the G_1, S, and G_2, and M stages was 5.8, 6.7, 4, and 1.3 hr respectively; after exposure to 400 rad it was 8.8, 7.7, 5, and 1.8 hr. Similar results were obtained in the pea root meristem. A decreased cell proliferation activity was found in irradiated plants. The amount of labeled cells following exposure to ^{3}H-thymidine decreased from 96.4% to 80.3% in bean plants and from 98% to 86.8% in pea plants. (HLW)

5960 EFFECT OF X RAYS ON THE MEIOTIC CELLS OF POECILOCERA PICTA. Gururaj, M. E.; Rajasekarasetty, M. R. Indian J. Hered.; 2: No. 2, 103-112(1970).

By utilizing 40, 80, 120, 240, and 320 R of x rays, dicentric bridges and side arm bridges were induced in the meiotic cells of P. picta. The dicentric bridges are considered to be produced both by chromosome breaks and isolocus sister chromatid breaks in either cases of which there is sister chromatid union and chiasma formation between the centromere and the locus of breakage. The degree of fragmentation was shown to influence the frequency of dicentric bridge formation. The side arm bridges are produced by the breakage of subunits of chromatids and their differential joining. It was shown that localization of the chiasma will determine the appearance of the sub-chromatid bridges in Anaphase I. The occurrence of the side arm bridges is considered to be reflective of the behavior of the chromosome as a quadripartite structure during pachytene to metaphase I to x radiation. (37 references) (Indian Sci. Abstr.)

5961 PERMANENTLY POLYMORPHIC CLONES OF DUCKWEED AS A MODEL FOR STUDY OF SOME PROBLEMS OF DEVELOPMENTAL BIOLOGY. Kasinov, V. B.; Kasinova, G. V. (Physical Technical Inst., Leningrad). Sov. J. Develop. Biol. (Engl. Transl.); 2: No. 6, 441-448(1971).

Translated from Ontogenez; 2: No. 6, 555-564(1971).

Colonies of duckweed, Lemna gibba, were x-irradiated with a dose of 800 R at a rate of 100 R/min. The colonies were cultivated on a solid mineral medium and radiation damage was assessed by means of a nondichotomous pedigree. Local deformation, decreased size of individuals, and temporary suppression of flowering were observed in the vegetative progeny. The concepts of equifinality and varifinality of living organisms are discussed. It was shown that the ability to produce deformed plants was retained permanently with asexual reproduction but was not transmitted to the sexually produced progeny. (HLW)

5962 GAS-CHROMATOGRAPHIC ESTIMATION OF SOLUBLE CONSTITUENTS OF POTATOES TREATED BY IRRADIATION AND WITH CHEMICAL SPROUT INHIBITORS. Rumpf, G. (Institut fuer Strahlentechnologie, Karlsruhe, Ger.). Potato Res.; 15: 236-245(1972). (In German).

The quantitative gas chromatographic estimation of fructose, glucose, sucrose, citric and malic acids, and myo-inositol in potatoes of three varieties is described. In December, 1969, different batches were irradiated, treated with chemical sprout inhibitors, or untreated; they were stored at 10°C. Between January and April, 1970, there was an increase in sugar concentration in the irradiated samples. The effect of this increase was deleterious. There was a decrease in citric and an increase in malic acid content with increasing storage time. There was a gradual increase of myo-inositol. (HLW)

Radiation Effects on Animals

Refer also to abstract 5905.

Man

Refer also to abstracts 5530, 5532, 5535, 6935, and 7195.

5963 (BNL-17796) EVALUATION OF ACCIDENTAL EXPOSURE TO ACCELERATOR PERSONNEL. Distenfeld, C. H.; Colvett, R. D.; Ash, J. A. (Brookhaven National Lab., Upton, NY). 4 Apr 1973. 23p. Dep. NTIS $3.25.

An accelerator radiation protection program should include means to evaluate accidental exposures. A method relating an accident victim's body activation to his absorbed dose was developed. The body activation is measured by a simple survey meter or a whole-body counter. A phantom filled with a tissue-equivalent solution, along with several dosimeters, was irradiated in the magnet enclosure of the Alternating Gradient Synchrotron. A calibration graph was prepared relating body activation, as measured by a midchest ion chamber reading, for various irradiation periods and post-irradiation times. The technique is capable of detecting exposures as low as 1 rad within a factor of two. (auth)

5964 (BNWL-SA-3390) RADIATION PROTECTION PRACTICES FOR TRITIUM. A Manual of Good Practice. Unruh, C. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jul 1970. 56p. Dep. NTIS $5.00.

This manual of good practice provides radiation protection guidance for working with tritium and tritium compounds. The practices presented are based on the experience of the AEC contractor laboratories and private industry. The manual provides specific information on the chemical and physical properties of tritium and facilities and protective equipment that can be useful in establishing and administering safe programs for working with tritium and its compounds, and also provides those relatively inexperienced in working with tritium with the background of experience that has been developed by other users. Emphasis is placed on the good practices required for working with purified tritium and its compounds. Other radionuclides are assumed to be absent. For work with tritium in association with other radionuclides additional good practices may be required, depending on the radionuclides involved. (CH)

5965 (BRH/DBE-73-2) EPIDEMIOLOGIST TAKES A LOOK AT RADIATION RISKS. Stewart, A. (Bureau of Radiological Health, Rockville, MD. (USA). Div. of Biological Effects). Jan 1973. 114p. GPO $1.25.

An edited version of five lectures is presented that explores the uses and limitations of epidemiology in assessing biological effects and hazards of ionizing radiation on men. Emphasis is placed on processing methods and approaches used by the Oxford Survey in associating childhood malignancies with diagnostic in utero exposure to x rays. (CH)

5966 (CONF-730603-1) MODEL FOR EXPOSURE TO A SEMI-INFINITE CLOUD OF A PHOTON EMITTER. Poston, J. W.; Snyder, W. S. (Oak Ridge National Lab., Tenn.). 1973. 15p. Dep. NTIS $3.00.

From 18th Health Physics Society meeting; Miami Beach, Florida, USA (17 Jun 1973).

The dose from a semi-infinite cloud of a photon-emitting radionuclide is an idealization of an exposure situation, but it is a useful one, particularly for noble gases of long radioactive decay half-times, e.g., ^{85}Kr. An analysis of absorbed dose to body organs for monoenergetic photons emitted in an infinite cloud is presented. Twelve photon energies in the range 0.01 to 4 MeV were used in these calculations, and the concentration in the cloud was considered uniform. The energy spectrum of scattered photons was first calculated by the method of Dillman, and the resulting fluence used as the source on an anthropomorphic phantom, essentially as considered in MIRD Pamphlet No. 5. The dose to the various organs was obtained by the Monte Carlo technique. Also a method is described that provides estimates of absorbed dose to organs by use of calculated depth dose profiles in the phantom. This method is used for those organs for which the coefficient of variation of the Monte Carlo estimate exceeded 30%. It is expected that dose from photons emitted in the decay of a real radionuclide could be obtained by interpolation from these results. (auth)

5967 (NEIC-RR-46) 8th REPORT ON RESEARCH CONDUCTED IN THE YEAR 1970. (Instytut Onkologii, Warsaw (Poland)). 1972. 171p. (In several languages). Dep. NTIS (U. S. Sales Only) $10.75.

Research studies on the etiology and early detection of neoplasms are discussed. Epidemiological surveys on morbidity from malignant tumors in selected regions of Poland were carried out in an attempt to establish associations between cancer risk and environmental conditions and other factors. Prognostic indications and results of radiotherapy alone, or combined with surgery, were evaluated for several thousand patients with carcinoma of the uterine cervix, breast, bronchus, or digestive tract or neoplasms of the hemopoietic and lymphatic systems, with emphasis on Hodgkin's disease. Data are included on the frequency and severity of radioinduced lesions of the intestinal and urinary tracts following therapy of carcinoma of the uterus and lesions of the lungs following therapy of breast neoplasms. Radiation sources used included ^{60}Co γ and x radiation beams, ^{60}Co γ applicators, and intralymphatic ^{131}I-labeled compounds in selected cases. Abstracts of 113 papers on oncology published during 1970 are included in Polish, with titles in Polish, Russian, and English. (CH)

5968 (ORNL-NSIC-107) INDEX TO NUCLEAR SAFETY. A Technical Progress Review by Chronology, Permuted Title, and Author. Vol. 1, No. 1 through Vol. 13, No. 6. Blakely, J. P.; Klein, A. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 144p. Dep. NTIS $8.00.

The articles appearing in Volume 1 Number 1 through Volume 13 Number 6 of Nuclear Safety are presented in three separate sections of the index. The first section is a chronological listing of the articles by volume, the second section is a permuted title (KWIC) index, and the third section is an author index. (ERB)

5969 RADIODERMATITIS. Folesky, H.; Zschunke, E. (Zentralinstitut fuer Arbeitsmedizin, Berlin). Z. Aerztl. Fortbild.; 66: No. 7, 363(1 Apr 1972). (In German).

Two patients received radiation to their hands during professional repair work on x-ray equipment. The doses amounted to about 3900 R in the first case, and to approximately 1500 R in the second case. In the two patients, severe radiodermatitis developed with epidermolysis and ulcerations. Early treatment with corticosteroids and vasodilating drugs apparently had a beneficial effect. (HBG)

5970 APPLICATION OF VARIABLE DOSE EQUIPMENT FOR EXTRACORPOREAL IRRADIATION OF BLOOD. Weeke, E. (University Hospital, Copenhagen); Rasmussen, I. pp 103-105 of Second Nordic Meeting on Medical and Biological Engineering. Oslo; Norsk Forening for Bio Medisinsk Teknikk (1972).

From proceedings of the second Nordic meeting on medical and biological engineering; Oslo, Norway (16 Jun 1971).

A series of special irradiators with variable transit dose setting was developed for immuno-suppressive, pre-transplantation therapy by Extracorporeal Irradiation of Blood (ECIB). The irradiators are designated ECIB-I, ECIB-II, and ECIB-III and are stationary, with a ^{60}Co source, mobile, with a ^{137}Cs source, and portable with a ^{90}Sr/^{90}Y source respectively. The depletion of lymphocytes in the peripheral blood is a major control parameter, and was studied on three groups of transplantation patients. Prolonged lymphopenia is obtained by high dose therapy, with occurrence of hemolysis when the mean total dose exceeds 30 krads. Satisfactory lymphopenia can be obtained at lower transit doses (100 rads) without causing hemolysis but periodic repetition of ECIB is required. Experience from β-therapy is still too limited to allow conclusions on still lower transit doses. (Norway)

5971 EFFICACY OF ESBERTOX IN THE TREATMENT OF RADIATION INDUCED LEUKOPENIA. Sartor, K. J. (Mercy Hospital and Medical Center, Chicago). Ther. Gegenw.; 111: 1147-1150(Aug 1972). (In German).

Telecobalt therapy was administered to 48 patients five times a week in single doses of 200 R. The patients had undergone radical surgery for malignant tumors but were free of metastases at the time of radiation treatment. They were divided randomly into a control group and an experimental group that received one tablet of Esberitox three times a day. Although the statistical evaluation failed to show a significant difference, it suggested strongly that the Esberitox treatment had a favorable effect in reducing radiation-induced leukopenia. (HBG)

5972 NEUROPATHOLOGIC EFFECTS OF PROTON-BEAM IRRADIATION IN MAN. I. Dose-Response Relationships After Treatment of Intracranial Neoplasms. Nielsen, S. L.; Kjellberg, R. N.; Asbury, A. K.; Koehler, A. M. (Massachusetts General Hospital, Boston). Acta Neuropathol.; 20: 348-356(1972).

In ten patients with intracranial tumor, treatment with proton-beam irradiation was followed by neuropathologic evaluation of autopsy material. Computer-determined isodose curves of radiation dosage aided the correlation of tissue damage with tissue dose of irradiation. Although we found variations in the vulnerability of different anatomic regions (and even within the same region), threshold levels for the effect of proton irradiation were defined. Variables other than tissue dose that determine the extent of damage to the brain include the volume of tissue irradiated, length of time following irradiation, and limitations in our own ability to establish tumor boundaries. Despite these variables, however, tissue reaction and threshold levels following proton-beam irradiation are similar to those of other modalities of radiation therapy. (auth)

5973 TEN YEARS OF DOSIMETRY ON ASTRONAUTS IN SPACE AND DEEP SPACE: RETROSPECT AND OUTLOOK. Schaefer, H. J. (Naval Aerospace Medical Inst., Pensacola, FL). Arbeitsmed.-Sozialmed.-Arbeitshyg.; 7: No. 9, 245-252(1972). (In German).

The radiation environment in space is made up mainly of nuclear components: trapped protons in the radiation belt, cosmic ray (galactic) particles and, for limited periods after major solar flares, solar protons. Trapped and solar protons, contrary to galactic ones, show a soft spectrum. Therefore, the inherent shielding of the vehicle affords substantial protection. Typical mission doses on lunar missions range from 400 to more than 1,000 millirems. Heavy nuclei of the primary galactic radiation represent a novel type of ionizing radiation well described with the word microbeam irradiation. While cellular destruction from single traversals by heavy nuclei has been demonstrated, total body effects from long-term exposures at low dose rates have not been investigated. The unique character of heavy nuclei is demonstrated by the eye flash phenomenon experienced by the astronauts under dark adaptation in deep space. For long duration space missions of the future, nuclear power sources will be indispensable for station maintenance. With weight at a premium, more liberal maximum permissible doses for reducing dead weight shielding have been advocated. The environmental radiation hazard ultimately must be seen in this combined perspective. (GE)

5974 RADIATION EXPOSURE OF CRITICAL ORGANS (GONADS AND LENSES) IN DIAGNOSTIC RADIOLOGY. Schmitt, G. (Bochum Univ., Essen); Ewen, K. Electromedica; 41: No. 1, 35-40(1973). (In German).

The radiation exposure of gonads and lenses as the most critical organs in some of the frequently applied radiodiagnostic measures, (thorax full size radiographs, investigation of the gastro-intestinal tract, urograms) is discussed. In addition to this, corresponding measurements were made during angiographic investigations of the abdomen (reno-angiography, angiography of the pelvis) and of the lower extremity. The highest gonad doses (to patients) were found in angiographic investigations of the pelvis of women (1,110 mR for seven angiographies), the lowest for full size radiographs of the thorax (two projections, high-kV technique, 3.7 up to 7.1 mR). The gonad dose to the investigating personnel in case of gastro-intestinal passages and angiograms was found to vary between 0.16 and 1.3 mR per investigation or series of angiograms (eight films being used in a series). The dose received by the lenses of the investigating personnel in angiographies was 30 mR (with eight films being used for every series). By appropriate protective measures it will be possible to reduce the doses by a factor of 20, approximately. (GE)

5975 INCIDENCE OF HYPOTHYREOSIS AFTER PERCUTANEOUS TELECOBALT IRRADIATION OF LARYNGEAL CARCINOMA. Brase, A.; Sippel, R. (Medizinische Hochschule, Hanover). Strahlentherapie; 145: No. 2, 147-154(1973). (In German).

In 72 patients treated with percutaneous ^{60}Co-irradiation in tumor doses because of laryngeal carcinoma, the thyroid function was tested during an observation period of up to 5 yrs. According to the results of the 2-phase tests with radioactive iodine and the parameters of the peripheric hormones, in seven cases (10%) a radiation-induced hypothyreosis was assumed and, consequently, hormone substitution was started, although only one case showed clinical symptoms of decelerated metabolic condition. As the development of myxedema is possible during a long period following radiation exposure of the thyroid gland, adequate function control is necessary during several years. The method to be chosen for this follow-up are the thyreospecific in vitro tests using PB ^{127}I and T_4. (GE)

5976 MANUAL ON RADIATION PROTECTION IN THE MEDICAL OFFICE. Radiation Protection During the Application of X rays and Other Ionizing Radiations. Second Edition. Graul, E. H.; Kuri, H.; Hess F.; Stockhausen, J. Cologne; Deutscher Aerzte-Verlag (1971). 97p. (In German).

The manual summarizes the lectures given during the advanced training courses on radiation protection, organized by the Bundesaerztekammer, (Federal Chamber of Physicians), under the following headings: physico-technical theory; basic principles in radiobiology; dose reduction and control of doses (local doses, personnel dosimetry, doses absorbed by patients and any third persons); legal provisions relating to radiation protection; and instructions for the application of ionizing radiation in practice (protection of patients and personnel). (GE)

5977 RADIATION-INDUCED CHANGE IN SERUM AND URINARY AMYLASE LEVELS IN MAN. Chen, I. W.; Kereiakes, J. G.; Silberstein, E. B.; Aron, B. S.; Saenger, E. L. (Univ. of Cincinnati). Radiat. Res.; 54: No. 1, 141-151(Apr 1973).

Serum and urinary amylase levels in cancer patients were studied before and after radiation treatment. Fourteen patients received radiation to the whole body, two to the upper body (above the xiphoid), and 9 to the lower body (below the xiphoid or from the base of the neck to the pubis). All patients received a single midline absorbed dose ranging from 100 to 300 rads. The peak postirradiation serum and urinary amylase levels in the patients receiving whole-body and upper-body irradiation were significantly higher than the preirradiation levels, while there was no significant change in the amylase levels in the patients receiving lower body irradiation. These results suggest that the serum amylase produced after whole body irradiation originates from salivary glands. Agar electrophoresis of postirradiation serums confirmed that the increased serum amylase activity is attributable to salivary amylase. No definite conclusion concerning dose-response relationship could be made from the present studies. (auth)

5978 HYPERALIMENTATION IN PULMONARY SURGERY. Rea, W. J.; Ecker, R. R.; Eberle, J. W.; Sugg, W. L. (Univ. of Texas, Dallas). Chest (Chicago); 62: No. 5, 577-580(Nov 1972).

A group of 14 patients with severe septic pulmonary complications were treated with Dudrick's intravenous hyperalimentation regimen. All were chosen by natural selection because of severe weight loss, emaciation, refusal and inability to eat, and appearance of impending death. In this group were nine patients with empyema, five with pulmonary abscesses (multiple), and four with bronchopleurocutaneous fistulae. All were severely septic. Five developed these complications after radiation of 3,000 rads plus surgery. Five had lobectomies in lungs that were previously infected, two were secondary to gun shot wounds (GSW) of the esophagus, and two occurred secondary to pneumonia. Serum albumin values were 3.0 or lower and weight loss was from 10 to 20 pounds. Therapy consisted of at least 18 grams of nitrogen plus 3,000 calories per 24 hrs and the usual surgical techniques. Meticulous monitoring of intakes, outputs, and central venous pressure was done. The length of intravenous therapy was from one to five months. Twelve of 14 patients survived. Nitrogen balance studies showed nitrogen losses up to 15 gm/24 hrs and sometimes it took two weeks before it became positive. This regimen appears to be a significant advancement in the adjunctive treatment of severe pulmonary sepsis and its complications. (auth)

5979 LIKELIHOOD ESTIMATION FOR CERTAIN TEMPORALLY NON HOMOGENEOUS PROCESSES (ANALYSIS OF ADOLESCENT GROWTH DATA FOR JAPANESE SURVIVORS IN UTERO AT THE TIME OF THE ATOMIC BOMBINGS OF HIROSHIMA AND NAGASAKI). Shohoji, T. New York; New York Univ. (1972). 232p. University Microfilms Order No. 73-9086.

Thesis (Ph. D.).

The large sample properties of maximum likelihood estimators are treated for certain temporally non-homogeneous growth processes; the observed random variables are not necessarily independent and identically distributed. It is shown that, under certain regularity conditions, similar asymptotic properties hold for this class of processes as for the more usual temporally homogeneous situation; the observed random variables are independent and identically distributed. Generalization and extension of some well-known theorems relating to the asymptotic properties of maximum likelihood estimators are presented. A four parameter Gompertz-type model is used to characterize growth during adolescence for Japanese subjects who were in utero at the time of the atomic bombings (ATB) of Japan in 1945. The maximum likelihood estimates obtained are shown to have the desirable large sample properties. Based on these estimates, statistical analyses were performed to test for differences between sexes, cities, trimesters ATB, and exposure groups. The results indicated that: males significantly differed from females in all comparisons; differences among male exposure groups (indicating some impairment in adolescent growth) were greater than those for females; males and females in Nagasaki differed from those in Hiroshima, respectively; differences among trimester ATB groups were, almost without exceptions, non-significant; and age at onset of menarche and estimated age at the second point of inflection of the Gompertz growth curve were closely related. (Diss. Abstr. Int., B)

5980 BONE MARROW TRANSPLANTATION IN A LEUKEMIC PATIENT FOLLOWING IMMUNOSUPPRESSION WITH ANTI-THYMOCYTE GLOBULIN AND TOTAL BODY IRRADIATION. Gengozian, N.; Edwards, C. L.; Vodopick, H. A.; Huebner, K. F. (Oak Ridge Associated Universities, TN). Transplantation; 15: No. 5, 446-454(May 1973).

A 50-year-old man with acute granulocytic leukemia was grafted with phenotypically HL-A-identical marrow after immunosuppression with horse antihuman thymocyte γ-globulin and total body irradiation exposure of 500 R given at a high rate. Engraftment was demonstrated by complete repopulation of the host by donor-type red cells. Hematological data and the absence of an aberrant cell line diagnostic for the leukemic cells following treatment suggested engraftment of platelets and granulocytes also. Immunoglobulin typing, however, suggested a lack of donor lymphocyte cell repopulation. Although the patient died 122 days post-transplant following infection with Pneumocystis carinii and acute renal failure, there was neither clinical nor autopsy evidence of a relapse of his leukemia and no evidence of graft failure. The ability to engraft marrow following what is perhaps a mid-lethal radiation dose for humans represents a significant step toward finding an immunosuppressive regimen that could be utilized safely for treating other hemopoietic dyscrasias. (auth)

5981 CORRELATION BETWEEN DELAYED HYPERSENSITIVITY AND RADIATION RESPONSE IN MAN. Bosworth, J. L.; Ghossein, N. A.; Brooks, T. L. (Albert Einstein Coll., Bronx, NY). Radiology; 107: No. 3, 683-684(Jun 1973).

Delayed hypersensitivity was correlated with the response of the tumor to irradiation in 54 patients. Twenty-four had an excellent radiation response; of these, 23 (96%) were positive to dinitrochlorobenzene (DNCB). Of 19 patients with head and neck tumors who demonstrated an excellent radiation response, 18 (95%) were DNCB-positive, suggesting a positive correlation between delayed hypersensitivity and tumor regression after radiotherapy. (auth)

5982 TIME–DOSE AND TUMOR VOLUME RELATIONSHIPS IN THE IRRADIATION OF SQUAMOUS CELL CARCINOMA OF THE TONSILLAR FOSSA. Shukovsky, L.; Fletcher, G. H. (Univ. of Texas, Houston). Radiology; 107: No. 3, 621-626(Jun 1973).

Megavoltage irradiation was used in treating 129 patients with squamous cell carcinoma of the tonsillar fossa. The data were analyzed with time-dose scattergrams and by using the nominal standard dose (NSD) to correlate the probability of control of the primary lesion with dose and stage (tumor volume). All early lesions (T_1) were controlled with 6,500 rads given in 6.5 weeks. For more advanced disease (T_2), 7,000 rads in 7 weeks (or its equivalent) was required in order to obtain a high probability of local control. The largest lesions (T_3 and T_4) have been most effectively treated with doses of 7,500 rads in 8 weeks (or its equivalent). Complications were correlated with dose and volume irradiated. (auth)

5983 INCREASED RATE OF COMPLICATIONS AS A RESULT OF TREATING ONLY ONE PRESCRIBED FIELD DAILY. Marks, R. D. Jr.; Agarwal, S. K.; Constable, W. C. (Univ. of Virginia, Charlottesville). Radiology; 107: No. 3, 615-619(Jun 1973).

The technique of treating only one prescribed field daily in a multifield setup produces an increased biological effect on the normal tissues. In a consecutive group of 18 patients with Hodgkin's disease all treated employing extended opposed fields on a ^{60}Co unit and treating only one prescribed field daily, 8 patients had delayed complications attributable to radiotherapy. All 18 were followed for more than four years. The concept of Nominal Standard Dose (NSD) was utilized in this study to compare the dosages in critical areas, i.e., the heart and spinal cord, relative to the tumor dose. Tolerance was exceeded to a greater extent in the patients with complications. (auth)

5984 HANDLING OF RADIOISOTOPES. Hightower, D. (Texas A and M Univ., College Station). J. Amer. Vet. Med. Ass.; 161: No. 11, 1549-1551(1 Dec 1972).

The extensive increase in the use of radionuclides and radiopharmaceuticals in medicine and research is discussed. Steps in obtaining licenses to use radionuclides are described. The importance of planning experiments in detail is pointed out and procedures for protection, such as use of protective clothing, waste disposal, and shielding are listed. Proper handling procedures are described for a hypothetical experimental situation. (HLW)

5985 NATURAL RADIOACTIVITY IN BUILDING MATERIALS: AN IMPORTANT COMPONENT OF THE RADIATION EFFECTS ON THE POPULATION IS BEING ANALYZED BY THE BMBW. Nucleus (Bonn); 18: No. 46-50, 410-414(1972). (In German).

Within the framework of investigations on the natural radiation dose of the population, statistical measurements are presently being performed in the FRG for the evaluation of the radiation doses in rooms by building materials. (GE)

5986 CALCIFICATION OF THE AURICULAR CARTILAGE AND BASAL GANGLIA SECONDARY TO RADIATION THERAPY. Williams, J. P.; Dixon, G.; Fowler, G. W.; Pribram, H. F. W.; Sargent, E. N.; Turner, A. F. (Univ. of California, Irvine). Bull. Los Angeles Neurol. Soc.; 38: 33-36(Jan 1973).

A case of calcification in the cartilage of the ear and in the head of the caudate nucleus bilaterally following irradiation for an optic nerve glioma is presented. A brief discussion of the probable mechanism is included. (auth)

5987 DIE STRAHLENREAKTIONEN DES GASTROINTESTINALTRAKTES. (Radiation Reactions of the Gastrointestinal Tract). Neumeister, K. Leipzig; VEB Georg Thieme (1973). 215p. 48,70 M.

Radioinduced changes in the morphology of the gastrointestinal tract are reviewed. Studies using animal experiments and clinical observations of cancer patients are discussed with regard to pathological effects of radiation on the gastrointestinal circulation, motility, secretion, and absorption. Effects of radiation on intestinal microflora are also reviewed. The clinical course of intestinal radiation reactions and the treatment of the intestinal radiation syndrome are discussed. A subject index and a list of more than 500 references are included. (HLW)

5988 REDUCTION OF PATIENT DOSE IN X-RAY EXAMINATION. Takashashi, S. (Nagoya Univ., Japan). Hoken Butsuri; 7: No. 2, 71-77(Jun 1972). (In Japanese).

In x-ray radiography, the surface skin of the patient is exposed to about 200 mR and to a dose of from 2 to 7 R/min in fluoroscopy. The incidence of genetic mutation and cancer is considered the most serious problem among radiation hazards induced by x-ray. In the investigation of the nationwide Japanese gonad dose caused by x-ray examination, the genetically significant dose (GSD) estimated with reference to data of child expectancy was 26.5 mrem/y in 1970. It is well known that irradiation to the bone marrow induces leukemia. Leukemia significant dose estimated by a method similar to that above was 196 mrem/y in 1969. Both the genetically significant dose and the leukemia significant dose caused by x-ray examination are higher than those caused by radiation waste or fallout of the explosions of the nuclear weapons and miscellaneous radiation sources. Standardization and determination of permissible dose should be more emphasized in the education or training in radiography. The limitation of the x-ray beam for clinical use is the most effective means to reduce the patient dose, in particular gonad dose and bone marrow dose. (auth)

5989 HIGH ENERGY X-RAY THERAPY. With Special Emphasis on Conformation Irradiation. Morita, K. (Aichi Cancer Center, Nagoya, Japan). Rinsho Hoshasen; 17: No. 10 Suppl., 754-762(Sep 1972). (In Japanese).

A therapeutic plan of esophageal tumors using conformation irradiation with high energy x rays is described in addition to the general discussion of the advantages of conformation irradiation including reduction in volume dose, protection of normal tissue around tumors, and massive dose irradiation for progressive tumors. Protection of normal tissue from radiation injuries is the most important aspect of radiotherapy of malignant tumors. In order to achieve this purpose, improvements in spatial dose distribution, time dose distribution, and radiosensitizing agents are considered. Of these, spatial dose distribution is regarded as the essential concern of current radiotherapy. The use of high energy x rays such as ^{60}Co gamma rays has been successful in reduction of skin surface dose and concomitant increase in depth dose without bone injuries. However, even with this build-up effect of high energy x-rays, efforts must be made to obtain equal dose distribution to tumors. Conformation irradiation, which was developed by Takahashi in 1960, is essentially one of rotation irradiation designed to concentrate dose distribution on tumors. That is, an attempt is made to produce dose distribution in accordance with the shape of tumors so that radiation exposure of normal tissue can be maintained at a minimum. The development of 4 to 6 MV x-rays has promoted the clinical application of this irradiation method. (Japan)

5990 OCCUPATIONAL RADIATION EXPOSURE AND RADIATION PROTECTION IN THE FIELD OF MEDICINE. Sakuma, S.; Maekoshi, H. (Nagoya City Univ., Japan). Rinsho Hoshasen; 18: No. 1, 1-9(Jan 1973). (In Japanese).

The paper reviews the present aspect of occupational hazards of radiation exposure and radiation protection in the field of medicine with reference to literature. According to the report of 1968, medical workers received an 0.38 rem exposure dose in average per year compared with 0.29 rem for industrial workers and 0.13 rem for employees in nuclear industries. Furthermore, 4% of the medical workers received more than the permissible exposure dose according to data obtained by an individual monitoring system using a film badge, indicating medical field workers are exposed to more irradiation in general than others. The paper also describes various methods of dosimetry of radiation exposure dose as well as radiation installations, x-ray television equipments, image display devices for surgery and laboratory equipment for radiotherapy and diagnosis in terms of exposure dose of those who handle these equipments. (Japan)

5991 WATER-FREE STANNOUS-FLUORIDE GEL AND POST-IRRADIATION CARIES. Miller, J. T.; Shannon, I. L. J. Pub. Health Dent.; 32: No. 2, 127(Spr 1972).

Dental caries in a ravaging form frequently is a complication in patients who have received irradiation for malignancies of the head and neck. The Dental Service of the VA Hospital in Houston has initiated a chemical program of prevention to reduce the high frequency of carious lesions in these patients. Along with detailed instructions for maintaining oral hygiene, the patients are instructed in the daily use of a water-free 0.4% stannous-fluoride gel. The stannous fluoride is stabilized by prior dissolution in glycerin. Patients are given the choice of applying the gel with either a plastic carrier or by toothbrush. A total of eight post-irradiation patients participated throughout the first 12 months of the program. Not one carious lesion has developed in these eight patients. On the basis of these preliminary results, the indication is that the stannous-fluoride gel is a highly effective agent in preventing the ravages of post irradiation dental caries. (auth)

5992 DISORDERS OF GASTROINTESTINAL MOTILITY IN THE IRRADIATED ORGANISM. Visnovsky, P. Cesk. Gastroenterol. Vyz.; 26: No. 6, 275-281(Sep 1972). (In Slovak).

Disruption of the gastrointestinal motility due to irradiation, which occurs in laboratory animals and humans is discussed. Emptying of the stomach and gastrointestinal tract is delayed, and there is nausea and vomiting. Some of the effects may be due to damage of the tract tissue, interference with the autonomic nervous system regulation, and pharmacologically active substances liberated by the insult to the body. Various therapeutic drugs that have been tested are discussed. (Review article, 70 references) (TTT)

5993 GONAD BURDEN IN ROENTGEN DIAGNOSIS OF CONGENITAL HIP DISLOCATION. Kratzsch, E. (Bezirkskrankenhauses, Karl-Marx-Stadt, Ger.). Deut. Gesundheitsw.; 27: 1810-1814(21 Sep 1972). (In German).

During 1955 to 1970, 1781 children were detected who had been subjected to a radiological examination of the pelvis several times for a congenital luxation of the hip-joint. According to dose values ascertained by phanto-measurements, probably only in eight boys (=4.4‰) of the birth-years 1951 to 1959 a gonad dose exposure exceeding 3 R was detected. As from the beginning of 1955 an almost continuous decline of the average number of radiological examinations and, consequently, of the gonad doses, was detected. Probably, this is in the first line due to a lowering of the complication rate owing to the early detection and early treatment of the children concerned, as well as owing to a qualitative improvement of orthopedic methods of treatment. In spite of this favorable development, we demand for radiological examinations of the pelvis in generative age, above all, in children, a strict indication, optimal methods of radiological examination, and general application of a suitable gonad protection, so as to keep the irradiation risk of the total population in population-genetic respect as low as possible. Duly considering all dose-lowering prerequisites, under the present conditions a genetic endangering of the children suffering from a congenital hip-luxation will not have to be expected any more. (auth)

5994 SCHEME FOR CHARACTERISING ASG BANDING AND AN ILLUSTRATION OF ITS USE IN IDENTIFYING COMPLEX CHROMOSOMAL REARRANGEMENTS IN IRRADIATED HUMAN SKIN. Bigger, T. R. L.; Savage, J. R. K.; Watson, G. E. (Medical Research Council, Harwell, Eng.). Chromosoma; 39: 297-309 (1972).

An example is given that illustrates the capacity of the ASG banding technique for the solution of complex radiation-induced structural changes such as those found surviving in human skin cells after radiotherapy. With the aid of a G-band numbering system developed for such analyses, a detailed comparison was made of banding patterns obtained and published by other authors. (auth)

5995 IN VITRO CHROMOSOMAL RADIOSENSITIVITY IN PATIENTS AND IN CARRIERS WITH ABNORMAL NON-DOWN'S SYNDROME KARYOTYPES. Higurashi, M.; Conen, P. E. (Hospital for Sick Children, Toronto). Pediat. Res.; 6: 514-520(May 1972).

In vitro tests of chromosomal radiosensitivity in five children and three adults with normal karyotypes as control subjects, in seven patients (children) with chromosomal abnormalities, and in six translocation carriers (adults) are reported. Peripheral blood samples from each individual and skin fibroblast cultures from four children in the control group, five patients with chromosomal abnormalities, and one translocation carrier were γ-irradiated with 10 and 100 rads. Nonirradiated duplicate cultures were used as controls. Blood cultures were harvested after 52 hr of incubation and fibroblast cultures were harvested 24 hr after irradiation. The frequency of chromosomal breakage caused by irradiation was calculated by subtracting the values for nonirradiated samples from those for irradiated samples. In normal control subjects, the number of chromosome-type breaks per cell per rad was 0.0024 ± 0.0009 and 0.0020 ± 0.0009 in lymphocytes of children and adults, respectively, and 0.0049 ± 0.0021 in fibroblasts of children. The number of breaks per cell per rad was 0.0055 ± 0.0017 in lymphocytes and 0.0082 ± 0.0013 in fibroblasts of patients, and 0.0040 ± 0.0018 in lymphocytes and 0.0063 ± 0.0017 in fibroblasts of carriers. In comparison with age-matched controls, significantly elevated frequencies of breaks per cell per rad were observed in cultured lymphocytes and fibroblasts of patients, and in cultured lymphocytes of translocation carriers. After irradiation with 100 rads, the number of dicentrics and rings per cell was significantly greater in both patients and carriers of chromosomal abnormalities than in control subjects. Therefore, chromosomes of cells of patients with chromosomal abnormalities and of translocation carriers were significantly more radiosensitive in vitro than those of control subjects. (auth)

5996 DECREE RELATING TO PROTECTION FROM THE HARMFUL EFFECTS OF X RAYS (X-RAY DECREE-RoeV). Bundesgesundheitsblatt; No. 18, 173-188(1973). (In German).

The new X-Ray Decree has now been published and will come into force on September 1, 1973. It covers x-ray installations and high-voltage devices in which x rays with a boundary energy of at least 5 keV up to 3 MeV may be produced and relates in the main to the radiation protection of medical personnel and patients during radiological investigations and radiotherapeutic measures, the conditions governing the granting of licenses, examination and approval of design, maximum permissible radiation doses, inspection of installations, and medical examinations. (GE)

5997 UNIVERSITY RADIATION SAFETY OFFICER AS A TEACHER. Roessler, C. E. (Environmental Engineering, Inc., Gainesville, FL); Dunavant, B. G.; Price, D. G. Health Phys.; 24: No. 4, 448-451(Apr 1973).

The involvement of the Radiation Safety Officer, the Radiation Safety Office, and the University Radiation Safety Committee in teaching on the university campus is discussed. It is stressed that the RSO should most definitely be involved in teaching since good radiation safety depends on educating the radiation users to good health physics practice and the question is not really should he be involved but how he should be. The manner of this involvement is discussed, the opportunities for teaching formally and informally and the RSO's own attitude are considered. (UK)

5998 CONTROL OF RADIATION CARIES. Coffin, F. (Royal Marsden Hospital, Sutton, Eng.). Brit. J. Radiol.; 46: No. 545, 365-368(May 1973).

The problems of oral hygiene are discussed and illustrated in relation to radiotherapy of neoplasms of the mouth and pharynx, and the subsequent diminution of salivary flow. Measures discussed include removal of all teeth before treatment, mouth washing, and in particular the fitting of acrylic splints that completely cover the teeth, and are left in place until the salivary flow has returned to normal. This can mean a period of two years or more, though in children the splints need to be renewed at intervals, with the development of permanent teeth. (UK)

5999 OXYGEN AND RADIOSENSITIVITY. Huda, M. N. (Hammersmith Hospital, London). J. Pak. Med. Ass.; 20: No. 1, 7-12(Jan 1970).

The radiosensitizing effects of oxygen are discussed with emphasis on applications to radiotherapy. Based on data from the literature, the advantages of high pressure oxygen in x-ray therapy are pointed out. Evidence is presented that unsuccessful radiotherapy is related to the presence of anoxic cells in tumors. Various methods are suggested for increasing the effectiveness of radiotherapy, such as inhalation of high pressure oxygen and the use of high LET radiations. The use of fast neutrons is recommended as the most effective radiotherapy. (HLW)

6000 PROBLEMS OF SPACE MEDICINE AND COSMIC BIOLOGY. Nicu, M. D. (Observatorul Astronomic, Bucharest). Stud. Cercet. Astron.; 17: No. 2, 275-282(1972). (In Rumanian).

Cosmic biology is rapidly becoming a specific branch of science involved in the study of problems of life outside of the earth and survival on other planets. Space medicine examines the pathological or physiological adaptation of the human organism in response to stresses caused by extraterrestrial flights. The large pressures and temperatures encountered at the time of entry of meteorites into the atmosphere were analyzed to determine whether they might be a factor in the formation of amino acids from a mixture of simple gases, exposed simultaneously to UV radiation. New techniques of polymerization were developed in cosmic biologic studies, leading to the synthesis of thymine; more recently the mechanism of interaction between proteinoids and polynucleotides was clarified. A mocking of Martian atmospheric conditions was used to synthesize certain components of sugars. Interaction of cosmic radiation with matter resulted in the formation of stable paramagnetic centers, observed during the study of free radicals. Astrobiology examines the survival of astronauts during extended space flights. The various problems facing this new branch of science are outlined. (27 references.) (TTT)

Vertebrates

Refer also to abstracts 5935 and 5939.

6001 (COO-1602-34) EFFECTS OF X-IRRADIATION ON STEROID BIOTRANSFORMATIONS BY TESTICULAR TISSUES. Progress Report, August 1, 1972–July 31, 1973. Ellis, L. C. (Utah State Univ., Logan. Dept. of Zoology). [nd]. Contract AT(11-1)-1602. 11p. Dep. NTIS $3.00.

A dose-response curve (450 to 50 R of whole-body x irradiation) relating androgen synthesis by minced and teased-tubular preparations, metabolism of testosterone, lipid peroxidation, catalase activity, and melatonin synthesis by the pineal gland to histological changes in the testis has been completed. All phenomena were affected by irradiation in a dose-dependent manner, and all were related to damage and repair of the germinal epithelium. Changes in lighting schedules were associated with changes in melatonin synthesis and changes in radiosensitivity of the testis. Melatonin has been shown to inhibit androgen synthesis, stimulate the inactivation of testosterone, and stimulate MAO activity of the testis. It inhibited MAO activity of the hypothalamus and pituitary and is thought to regulate trophic hormone release as a result of increasing serotonin levels in the brain. An increased 5α-reductase of the testis and liver by melatonin and other radiation products is thought to be responsible for decreasing androgen levels in the gonad and increasing steroid metabolites that induce fever in the general radiation syndrome. (auth)

6002 (COO–2269-1) KINETIC AND BIOCHEMICAL STUDIES ON TUMOR GROWTH. Comprehensive Progress Report, October 1, 1967–July 14, 1973. Dethlefsen, L. A. (Utah Univ., Salt Lake City (USA). Dept. of Radiology). 1973. Contract AT(11-1)-2269. 13p. Dep. NTIS $3.00.

The growth kinetics of three lines of the C3H mammary tumor were studied by standard autoradiographic procedures in combination with volumetric growth curve analysis. Thus, such parameters as volumetric doubling times, mean cell generation times, growth fraction, and cell loss were measured. A direct method (^{125}I-IUdR Method) for measuring cell loss was also developed. This method consists of injecting the mice with ^{125}I-IUdR and then measuring the loss of ^{125}I-activity from the tumor. This method was used in the tumors from the three lines and the loss of ^{125}I-activity correlates with cell loss as defined by the standard procedures. The antigenic status of these tumors was studied as one possible factor underlying the different growth kinetics. The mouse's immunological system was either suppressed (thymectomy and whole-body x-irradiation) or stimulated (previous exposure to tumor cells) and the percent takes, latent period, and growth rates measured. There was no evidence for a strong antigenic factor in any of these tumors. The perturbing effects produced by single doses of hydroxyurea were studied in the duodenum and S102F tumors. Again the methods used were standard autoradiographic and volumetric growth curve analysis along with measurements on the rates of DNA synthesis. Single doses of hydroxyurea kill the S-phase cells, produce some degree of cell synchrony, some reduction in the cell-cycle times, and an increase in the growth fraction. Two-dose experiments are now in progress. (auth)

6003 (COO–2269-2) KINETIC AND BIOCHEMICAL STUDIES ON TUMOR GROWTH. Annual Progress Report, July 15, 1972–July 14, 1973. Dethlefsen, L. A. (Utah Univ., Salt Lake City (USA). Dept. of Radiology). 1973. Contract AT(11-1)-2269. 5p. Dep. NTIS $3.00.

The work focused on the cellular kinetics of unperturbed C3H mouse mammary tumors and on the cellular kinetics of the duodenal crypts and tumors (S102F line) following injections of hydroxyurea(HU). Information is available on such parameters as: volumetric doubling times, mean cell generation times, growth fraction, and cell loss. The studies on the HU-produced perturbations in the duodenum and S102F tumors were completed for single large doses (3 mg/gm body wt). Tumor-bearing mice are injected with HU and the perturbation in tumor growth observed or the mice are injected with ^{3}H-thymidine at various times and the rates of DNA synthesis measured. This dose of HU produces a temporary delay in tumor growth, and at the cellular level, kills the S-phase cells in both tissues and synchronizes the cells, however, only minimally in the tumor. On recovery, the generation time of the crypt cells is reduced and the proliferating fraction increased while in the tumors, the cell generation time is not reduced significantly but the growth fraction is increased. The two-dose studies are in progress, here the second HU injection is given either at 9, 12, or 24 hours after the first. This interval is based on the synchronization of the crypt cells from a single dose of HU. The antigenic status of the tumors was also studied by immunosuppression (thymectomy and whole-body radiation) and stimulation of the host's immune mechanism (previous exposure to tumor cells), and both studies showed that the tumors from these three lines are not highly antigenic. (auth)

6004 EFFECT OF ANDROGENS ON ERYTHROID AND GRANULOCYTIC MARROW RECOVERY IN THE IRRADIATED RAT. Horn, Y.; Price, D. C. (Univ. of California, San Francisco). Acta Haematol.; 48: 300-306(1972).

A study was performed on the effect of testosterone on post-irradiation recovery of bone marrow and circulating granulocytes in the rat. Testosterone accelerated recovery of peripheral polymorphonuclear leukocytes, more so if therapy was initiated prior to irradiation. Increased marrow ^{59}Fe compared to controls confirmed the simultaneous erythroid stimulating effect of testosterone. Technetium-99m-sulfur colloid uptake in the marrow was also noted to be increased in all irradiated groups without a differential testosterone effect, perhaps reflecting a post-irradiation recovery response of increased vascularity. The possible mechanisms are discussed. (auth)

6005 NUKLEINOVYE KISLOTY I BELKI V ORGANIZME PRI LUCHEVOM PORAZHENII. (Nucleic Acids and Proteins in the Organism During Radiation Damage). Fedorova, T. A.; Tereshchenko, O. Ya.; Mazurik, V. K. Moscow; Meditsina (1972). 408p.

Metabolism of nucleoproteins, proteins, and nucleic acids in irradiated organisms is discussed. The synthesis of DNA and the breakdown of desoxyribonucleoprotein and DNA in the tissues of irradiated rabbits and mice (most commonly, with ^{60}Co sources) are considered in detail. The therapeutic effects of nucleic acids during radiation sickness are examined. (~1000 references). (KSW)

6006 INFLUENCE OF O-(β-HYDROXYETHYL)-RUTOSID ON LOCAL RADIATION DAMAGE AND THE REGENERATIVE POWER OF TISSUES IN ANIMAL EXPERIMENTS. Mueller, G.; Dihlmann, W.; Fernholz, H. J. (Technische Hochschule, Aachen). Strahlentherapie; 145: No. 1, 68-75(1973). (In German).

After a single local irradiation of rabbit ears with 6,000 and 10,000 R and continuous intramuscular application of 50 mg of O-(β-hydroxyethyl)-rutosid per kg body weight, the influence of this substance on the course of the radioreaction in the rabbit ear was examined. The effect on the radiation damage and the regeneration of the tissues was histologically evaluated, according to different parameters of skin, soft tissue, cartilage, and vessels. A favorable effect of Venoruton on late radiation damages due to a disturbed regeneration potency, especially of soft tissue and cartilage, is demonstrated. (GF)

6007 DISTRIBUTION AND INCORPORATION OF [^{3}H]OROTIC ACID IN FREE AND MEMBRANE-BOUND RIBOSOMES IN RAT LIVER AFTER WHOLE BODY γ-IRRADIATION AND PROLONGED FASTING. Ekren, T.; Yatvin, M. B. (Univ. of Wisconsin, Madison). Biochim. Biophys. Acta; 281: 263-269(11 Oct 1972).

Following either whole-body γ irradiation or prolonged fasting, membrane-attached ribosomes in liver were more heavily labeled with [^{3}H]orotic acid than free ribosomes. Furthermore, there was a higher percentage of free ribosomes in the selected post-mitochondrial population. In contrast, the distribution of these two classes of ribosomes in the post-nuclear supernatant was unaltered. Thus, it appears unlikely that the irradiated liver cell responds by increasing free ribosome synthesis following exposure. (auth)

6008 LEVELS OF NUCLEIC ACIDS, PROTEIN, AND PHOSPHATASES IN NORMAL AND X-IRRADIATED GUINEA PIGS. Bhatavdekar, J. M.; Chinoy, N. J.; Shah, V. C. (Gujarat Univ., Ahmedabad, India). Strahlentherapie; 145: No. 1, 83-87(1973).

The effect of x-irradiation on alkaline and acid phosphatases, nucleic acids, and protein were studied biochemically in normal, irradiated, and recovering guinea pig tissues. The concentrations of phosphatases were significantly decreased on x-irradiation, and normal values were not obtained even after 72 hours of recovery. RNA and protein metabolisms were slightly activated while DNA metabolism decreased on irradiation. Although the radiation dose of 120 R affected the concentrations of phosphatases, nucleic acids, and protein, there was no severe injury noticeable. The significance of these alterations in relation to cellular metabolic processes is discussed. (GF)

6009 POSTNATAL GROWTH IN PRENATALLY IRRADIATED RATS. I. Exposure Rate Effect on the Liver, Kidney, Spleen, and Thymus. Martin, P. G. (Univ. of Tennessee, Oak Ridge). Growth; 37: No. 1, 55-67(Mar 1973).

The influence of a 160-R exposure to γ radiation delivered at 1, 3, and 47 R/min to rats in their 18th day of gestation on postnatal growth of the liver, kidney, spleen, and thymus from birth to day 63 was examined. The test for homogeneity of regression (organ weight against age) using a cubic polynomial indicated the individual organ for the 3 exposure rate groups was different from controls. The regression lines for the irradiated groups were parallel but characteristic for each individual organ between birth and day 30. Although an inverse relationship between exposure rate and organ weight was usually evident, an exposure rate response was significant only in two hemopoietic organs, the thymus ($P < 0.06$) and the spleen ($P < 0.05$), but not in the liver and kidney. Reasons for the four different postnatal recovery patterns in the irradiated organs when compared to controls are discussed in relation to age at irradiation and sensitivity of cell types. (auth)

6010 FRACTIONATED X-RADIATION DAMAGE TO DEVELOPING MONKEY OVARIES. Andersen, A. C.; Nelson, V. G.; Simpson, M. E. (Univ. of California, Davis). J. Med. Primatol.; 1: No. 5, 318-325(1972).

Two female monkeys (Macaca radiata) were sterilized after receiving 10 R x radiation twice weekly (total 270 R) while in utero. The ovaries of both animals were afollicular at 1 year of age; one contained a luteoma. (auth)

6011 DENSITY AND VOLUME DISTRIBUTIONS OF NORMAL AND IRRADIATED BLOOD CELLS. Kvaas, R. A. Los Angeles; Univ. of California (1972). 166p. University Microfilms Order No. 73-10,439.

Thesis (Ph. D.).

Buoyant density gradient centrifugation in linear bovine serum albumin gradients was used to separate a heterogeneous population of peripheral blood cells into homogeneous populations of monocytes, lymphocytes, granulocytes, and erythrocytes. The medium used consisted of bovine serum albumin to which G acid was added to considerably reduce the large amount of clumping that existed in earlier studies. A modified Coulter counter in conjunction with a multichannel pulse-height analyzer was used to determine the volume distributions of the populations of cells separated in these density gradient experiments. For both humans and rabbits the density of the different populations in order of increasing density was the following: monocytes; lymphocytes; granulocytes; and erythrocytes. In the granulocyte series of rabbits, the basophils had the lightest density, while the neutrophils had an intermediate density, and the eosinophils had the highest density. The heterogeneous population of rabbit lymphocytes was separated on the basis of density into many subpopulations of lymphocytes having different mean volumes. The rabbit lymphocytes that had the lightest density had the largest volume, while the lymphocytes that were the most dense had the smallest volume. Normal rabbit reticulocytes were separated from normal rabbit erythrocytes on the basis of density. When rabbits were exposed to 200 R cobalt-60 gamma irradiation, the mean density of the lymphocyte density distribution became lighter than the mean density of the controls as early as three hours after irradiation and for at least seventeen days afterwards. Starting as early as three hours after irradiation and for seven subsequent days, there was a progressive decrease in the mean density of the lymphocyte density distribution. After 200 R irradiation, an even larger and more immature population of rabbit reticulocytes appeared in the rabbit peripheral blood for about ten days after irradiation. This immature population of reticulocytes was separated into a lighter density fraction than the more mature reticulocytes. On days ten, eleven, and seventeen, after the 200 R irradiation, an extremely large number of basophils appeared mostly in the lighter fractions, with some fractions having as many as twenty-six percent basophils according to the differential counts. These experiments also demonstrated that of the three types of granulocytes, the rabbit basophils were by far the least phagocytic. (Diss. Abstr. Int., B)

6012 EFFECT OF OZONE ON THE GROWTH OF TUMORS AND IRRADIATION RESULTS IN ANIMAL EXPERIMENTS. Teske, H. J.; Badenberg, B.; Hoffmann, W. (Bochum Univ., Essen). Strahlentherapie; 145: No. 2, 155-160(1973). (In German).

The investigations made on 640 juvenile female mice to study the influence of intraperitoneally administered ozone on the transplantable chondrosarcoma and the C3H-tumor are reported. Three different doses were applied: 0.007, 0.07 and 0.7 gamma per gram of body weight per day. Moreover, the influence of unsaturated fatty acids on the growth of the tumors and the irradiation effect was tested. As expected, the local irradiation effect with 400 R was highly significant in all cases. In none of the cases could an inhibition of the growth of the tumor by administration of unsaturated fatty acids be observed. The effect of ozone or x rays was also not increased in the experiments by the diet with fatty acids. In the C3H-tumor, ozone is only efficient in the lowest dose and under simultaneous x ray irradiation; otherwise, it does not influence the growth of the tumor. The growth of the chondrosarcoma was inhibited by each of the three different ozone doses, with direct dependence of the growth-retardation on the dose. Under simultaneous x ray irradiation, only the highest concentration led to an additional growth-retardation of the tumor which exceeds the irradiation effect. In this case, the effects of ozone and irradiation are not completely additive. (GE)

6013 EARLY EFFECTS OF ^{60}Co GAMMA RADIATION ON CEREBRAL CATECHOLAMINES, SEROTONIN, AND RELATED COMPOUNDS. Pausescu, E.; Chirvasie, R.; Teodosiu, T.; Lugojan, R.; Muntiu, M. (Spitalul Fundeni, Bucharest). Strahlentherapie; 145: No. 1, 76-82(1973).

The effects of whole-body exposure to ^{60}Co gamma rays, at a single dose of 400 rad, on the catecholamines, serotonin (5-HT), some related compounds, and some enzymes subserving their metabolism in the rabbit brain were studied. A statistically significant increase in contents of dopa, dopamine, adrenaline, and especially noradrenaline and 3,4-dihydroxymandelic acid and a slight, statistically unsignificant, decrease in 5-HT concentration were observed 24 hrs after irradiation. An activation of both dopa (hydroxytryptophan)-decarboxylase and monoamine oxidase was also found. The data suggest that cerebral catecholamines are mainly affected in the initial post-irradiation period as compared with cerebral 5-HT, and that their changes follow an opposite pattern in this period as compared with the findings of other authors for subsequent periods in the same species. (GE)

6014 BIOLOGICAL IN-VIVO DOSIMETRY OF 15-MeV NEUTRONS IN NORMAL AND TUMOR CELLS. Cell Labeling with Iodo-125 Deoxyuridine. Porschen, W.; Feinendegen, L. E. (Kernforschungsanlage, Juelich, Ger.). Strahlentherapie; 145: No. 1, 27-38(1973). (In German).

In the living mouse, the RBE for fast neutrons was measured for different biological endpoints. The measurements involved cells capable of incorporating 5-iodo-2′-deoxyuridine (IUdR) into DNA. The rate of IUdR incorporation into the whole body declined following irradiation. The highest response was seen when the tracer was injected 4 hrs after irradiation. For that time interval, the RBE was about 4. When the precursor was injected 0.5 hr after irradiation, the rate of incorporation mainly reflected the rate of DNA synthesis. For this endpoint, the RBE was 2.3. The rate of IUdR incorporation into cells of the solid tumor Sarcoma 180, transplanted into the hind leg, also declined following tumor irradiation. The RBE for this endpoint was found to be 1.9. The rate of loss of precursor from the tumor cells temporarily increased following irradiation. The time of reversion of the rate of loss of precursor to the normal rate appeared to be dose-dependent. The RBE for this endpoint was 1.8. The relative amount of precursor finally lost from irradiated tumor cells was dose-dependent. It is interpreted to reflect the degree of cell killing. For this endpoint, the RBE was found to be approximately 5. These data suggest that the RBE for fast neutrons for normal cells and for tumor cells of Sarcoma 180 is higher for cell killing than for depression of the DNA synthesis rate. (GE)

6015 RADIATION-PROTECTIVE PROPERTIES OF TRICHLORFON. Wisniewski, K.; Panek, R.; Szymanski, R.; Killar, M.; Daniluk, J. (Akademia Medyczna, Bialystok, Poland). Strahlentherapie; 145: No. 2, 178-186(1973). (In German).

It is known from the literature that acetylcholinesterase (AChE)-inhibitors exert a certain radiation-protective effect. It therefore was expedient to investigate the radiation-protective properties of Trichlorfon, a phosphoorganic compound, with regard to its influence upon survival rate, hematologic changes, radiation-induced toxemia, and enzymatic changes. Apart from an inhibitory effect on the AChE-activity, this compound causes various metabolic effects. The experiments were performed on Wistar-rats, which got Trichlorfon in doses of 25, 100, or 200 mg per kg body weight. It was ascertained that only the dose of 100 mg per kg produces a satisfactory radiation-protective effect with regard to the survival rate (DRF = 1.18). The research on the hematological changes proved that Trichlorfon prevents to a certain degree the irradiation-induced decrease of the number of leucocytes on the 7th and 14th day following irradiation. The research on the irradiation-induced toxemia showed that this compound protects against the radiation induced increase of the lipoid-peroxides, without any influence on the O-quinone level. The research on the cathepsin activity indicated that Trichlorfon intensifies the activity of this enzyme in healthy animals and prevents to a high degree the radiation-induced increase. According to communications by Fillipovich concerning the effect of radiation-protective thiol-compounds, the metabolic effects observed exclusively after application of a radiation-protective dose of Trichlorfon (increase of oxygen consumption and cathepsin activity) can be considered as biochemical cell shock. These compounds seem to play an important part in the mode of radiation-protective action. Here, the inhibition of the AChE-activity is insignificant. (GE)

6016 BIOSYNTHESIS OF CHOLESTEROL IN MOUSE LIVER AFTER COMBINED X IRRADIATION AND TREATMENT WITH ACTINOMYCIN D. Berndt, J.; Heil, T. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Neuherberg, Ger.). Strahlentherapie; 145: No. 2, 216-228(1973). (In German).

The biosynthesis of cholesterol from labeled acetate was investigated in liver homogenates of mice treated with x rays or actinomycin D or a combination of the two. After a whole-body x irradiation with various x-ray doses, the synthesis of cholesterol from acetate was greatly increased. The extent of the stimulation depends on the radiation dose and varied from twofold (690 R) to twentyfold (1,700 R) compared with controls. The synthesis of cholesterol from mevalonic acid is only slightly affected under these circumstances. After the administration of actinomycin D, a similar effect was observed. This antibiotic enhanced the synthesis of cholesterol from acetate. The extent of the stimulation was likewise dose-dependent, and 24 hrs after the injection of 60 μg of actinomycin D per 100 g body weight a twentyfold increase of the synthesis of cholesterol occurred. Here also the cholesterol synthesis from mevalonic acid was only slightly affected. Thus, 1,700 R x rays and 60 μg of actinomycin D stimulated the cholesterol synthesis to almost the same extent. In further experiments, a combination of x irradiation and actinomycin D treatment was performed. The x-ray dose, the amount of actinomycin D, and the timing of the application of the antibiotic were varied. Under all experimental conditions used, actinomycin D did not potentiate the effect of x rays, as was expected, but it rather abolished completely the effect of the x rays. No stimulation at all was found and the synthesis of cholesterol in the combination experiments was of the same order of magnitude as that of untreated animals, i.e., controls. Actinomycin D is known to be a radiosensitizer; however, it obviously does not reveal this mode of action in the hepatic cholesterol synthesis. (GE)

6017 BEHAVIOR OF PHA-INDUCED TRANSFORMATION OF RAT LYMPHOCYTES AFTER WHOLE-BODY IRRADIATION. Kaercher, K. H. (Univ., Vienna); Madl, W.; Hansen, A. Strahlentherapie; 145: No. 2, 203-206(1973). (In German).

Young female Wistar rats were exposed to fractionated whole-body irradiation with ^{60}Co gamma rays in doses of 20 × 5 and 10 × 10 R. The rats were sacrificed either immediately after irradiation, or after 14 days, 2 months, and 7 months, by bleeding to death. The lymphocytes isolated from the blood were cultivated at 37°C after admixture of 0.1 ml of PHA. Cultivation of one part of the cells was discontinued after 72 hrs in order to determine the percentage of blasts in the smear. After 70 hrs, another part of the cell culture was incubated with ^{3}H-thymidine for 2 hrs in order to measure the incorporated activity. After a period of 14 days following whole-body irradiation with 20 × 5 R, no significant change in the stimulation of transformations could be found. Irradiation with 10 × 10 R, however, was found to increase significantly the transformation of lymphocytes, as was indicated by a high rate of incorporation of ^{3}H-thymidine and by the increased number of blasts. Two possible interpretations of these results are given. (GE)

6018 CHEMICAL RADIOPROTECTION AGAINST CHROMOSOME REARRANGEMENTS INDUCED IN SPERMATOGONIA OF MICE. Leonard, A.; Deknudt, G. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Strahlentherapie; 145: No. 2, 174-177 (1973). (In German).

The protective effect of a mixture of reduced glutathione (GSH), 2-β-aminoethylisothiouronium-Br-HBr (AET), mercaptoethylamine (MEA), cysteine, and serotonin creatinine sulphate or 5-hydroxytryptamine (5-HT) against the radiation-induction of reciprocal translocations in spermatogonia of mice tested by analyzing the dividing spermatocytes at the diakinesis. The cytological findings show that the frequency of spermatocytes with chromosome rearrangements is very low in the controls or in nonirradiated mice receiving the mixture. Pretreatment with the mixture before radiation exposure decreased significantly the percentage of abnormal metaphases. (GE)

6019 MECHANICS, PHOSPHOLIPOID CONTENT, AND MORPHOLOGY OF THE RAT LUNG AFTER IRRADIATION WITH ^{60}Co. Ruefer, R. (Max-Planck-Institut fuer Experimentelle Medizin, Goettingen, Ger.); Merker, H. J.; Bublitz, G. Strahlentherapie; 145: No. 1, 55-67(1973). (In German).

The effect of ^{60}Co irradiation on the alveolar surface forces was studied in the lungs of rats that were observed for 7 days to 3 months following an application of 3,000 R. A time depending correlation was observed between the formation of atelectasis, increased opening pressures shown by static pressure volume diagrams, a breakdown of the alveolar surface films visible in electron microscopy, and a decrease of the phospholipoid content in irradiated lungs. These changes indicate that—besides the tissue component—an increase of the alveolar surface forces may be responsible for disordered breathing mechanics following irradiation of the lungs. (GE)

6020 EFFECT OF OXYGEN ON THE RADIOPROTECTING PROPERTIES OF THREE NITRATE HETEROCYCLIC SUBSTANCES AND THE EFFECT OF THESE SUBSTANCES ON THE TOXICITY OF HYPERBARIC OXYGEN. Mourret, A.; Agnius-Delord, C.; Rinaldi, R. (Univ., Grenoble, France). Compt. Rend., Ser. D; 275: No. 25, 2985-2988(18 Dec 1972). (In French).

It is shown that hyperbaric oxygen (1.1 to 2.5 atmospheres) does not modify the LD 100/30 radiation, strongly reduces the radioprotecting properties of imidazole and benzimidazole, but does not have any effect on naphazoline or cysteamine (reference substance). In addition the action of these compounds on the survival of animals placed in oxygen pressures of between 3.5 and 5.8 atmospheres was studied. In this way it was shown that naphazoline like cysteamine is oxygen-protecting at medium pressures and that male animals are more sensitive than female animals to the action of oxygen. (FR)

6021 EXPERIMENTAL INDUCTION OF BENIGN MESENCHYMAL JAW TUMORS. Eulderink, F.; van Rijssel, T. G. (State Univ., Leiden). Pathol. Eur.; 7: No. 2, 144-150(1972).

Benign mesenchymal jaw tumors were induced in (WLLf × O_{20}) F_1 hybrid mice. These mice were treated by x irradiation of the head (one dose of 1000 or 500 rads) and/or chronic mechanical irritation of the intra-alveolar tissues by implanted threads or wires. These tumors closely resemble the benign mesenchymal jaw tumors in man (osteofibroma, cementofibroma) as regards the histological picture, sex ratio, and (probably) their appearance at an earlier age than is found for carcinomas. These tumors were most frequent in mice treated with a combination of irradiation and implantation of nylon threads, especially when the treatment was started at a relatively young age. (auth)

6022 SURFACE STUDIES OF ACUTE RADIATION INJURY IN THE MOUSE INTESTINE. Carr, K. E. (Univ. of Glasgow); Toner, P. G. Virchows Arch., B; 11: No. 3, 201-210(1972).

The scanning electron microscope was used to follow the changes induced by radiation in the surface structure of the small intestinal mucosa in mice. Adult mice were exposed to whole-body irradiation from a ^{60}Co γ-source. Dose levels of 1,500 to 2,500 rads were used, these being in excess of the lethal range. At intervals after irradiation the animals were killed, the proximal small intestine was removed, and the radiation-induced changes in the surface structure were studied by means of scanning electron microscope. Attention is drawn to changes in the surface creases that are a normal feature of the intestinal villus. There was a progressive disintegration of villous architecture leading finally to gross surface irregularity. The appearances were quite different from those seen in the villous atrophy of human coeliac disease. (GE)

6023 VULNERABILITY OF THE BRAIN OF THE GUINEA PIG TO CONVENTIONAL X RAYS DURING THE POSTNATAL PERIOD. Babbel, D.; Lierse, W.; Franke, H. D. (Univ., Hamburg). Strahlentherapie; 145: No. 3, 325-333(1973).

Guinea pigs aged 1, 5, 10, and 20 days, were irradiated with single doses of 100 R, 500 R, 1,000 R, or 2,000 R; 24 hrs following irradiation the brain was examined in order to demonstrate the regional presence of glycogen and glucosamines, as a sign of cell damage. The frontal cortex, the hippocampus, and the cerebellum proved to be radiosensitive. Centrally situated regions such as basal ganglia and thalamus are resistant. For the examined regions vulnerability phases are determined, which differ from the phases of adult brains. (GE)

6024 RADIATION DAMAGE TO THE BRAIN OF RATS IN THE POSTNATAL PERIOD. Gaertner, U.; Lierse, W.; Franke, H. D. (Univ., Hamburg). Strahlentherapie; 145: No. 3, 308-316(1973). (In German).

For this series of investigations, four rats each, males and females, either 0, 5, 10, or 20 days old, received a partial-body irradiation of the head with conventional x rays at doses of 500 or 1,000 R. Seven non-irradiated animals served as controls. The radiation doses were measured in a phantom placed next to the rats. The animals were killed 25 hrs after irradiation and the brains were prepared for optical microscopy. The following reactions were performed: PAS-reaction with or without pretreatment with diastase; iron-binding-reaction according to Hale; astrablue-reaction. The regional radiosensitivity of the brain corresponds to the critical phases of the postnatal development of the brain, with the exception of the thalamus and the basal ganglia. (GE)

6025 INFORMATSIONNYE MAKROMOLEKULY PRI LUCHEVOM PORAZHENII KLETOK. (Information Macromolecules During Radiation Injury to Cells). Komar, V. E.; Khanson, K. P. Moscow; Atomizdat (1972). 160p.

A study is made of the effect of ionizing radiation and chemical radiosensitizers on the structure and functional activity of the genetic apparatus of the cell. Data concerning the effect of irradiation on the structure of DNA and DNP are discussed, as well as the role of structural damage of the information macromolecules in disturbing processes of nucleic metabolism and protein synthesis. Catabolic processes and their role in the realization of radiation cell damage are considered. Particular attention is paid to the biochemical bases of interphase cell annihilation and to the nature of radiosensitivity of synchronous cell populations. (IAA)

6026 EFFECT OF X IRRADIATION ON GASTRIC SECRETION IN THE INTACT GUINEA PIG. Capoferro, R. (Univ. of Oslo). Scand. J. Gastroenterol.; 7: No. 7, 599-602(1972).

Volume, pH, and total acidity of the basal and of the stimulated gastric secretion were measured in guinea pigs before, and at appropriate intervals after, x irradiation to the stomach area. A great reduction of the stimulated acidity and acid output was found. It reached a maximum between the second and fourth week after irradiation. Thereafter the total acidity increased gradually, but, 56 weeks after irradiation, it still remained significantly below the normal ($p < 0.05$). The volume was lowered to a lesser extent. (auth)

6027 EFFECT OF X IRRADIATION ON THE PARIETAL CELL POPULATION IN THE INTACT GUINEA PIG. Capoferro, R. (Univ. of Oslo). Scand. J. Gastroenterol.; 7: No. 7, 603-607(1972).

Histological studies and parietal cell counts were carried out in guinea pigs after x irradiation to the stomach area. There was a pronounced reduction of the parietal cell mass, parietal cell density, and glandular mucosal volume. A reduction of a lesser degree persisted one year after irradiation, although the mucosa appeared almost normal. The histological changes were most pronounced during the period of two to four weeks after irradiation and resembled those seen in humans with chronic atrophic gastritis. (auth)

6028 EFFECTS OF OXYGEN ON INTESTINAL CRYPT SURVIVAL IN COBALT-60-IRRADIATED MICE. Sigdestad, C. P.; Hagemann, R. F.; Scott, R. M. (Univ. of Louisville, KY). Radiat. Res.; 54: No. 1, 102-109(Apr 1973).

Intestinal crypt survival was studied in mice irradiated in air, 100% normobaric oxygen, 100% hyperbaric oxygen (30 psi), and 6% normobaric oxygen. Exposures were from 900—2000 R at the rate of 47 R/min. The results demonstrated no difference in crypt survival for mice irradiated in air, normobaric oxygen, or hyperbaric oxygen. The crypt survival of mice was shown to have a D_0 from 377 to 380 R and a n from 7.9 to 9.7 for mice irradiated in air, 100% oxygen, or 100% oxygen at 30 psi, while mice irradiated in 6% oxygen had a $D_0 = 529$ R with a $n = 8.1$. The DMF (ratio of D_0 in 6% oxygen to D_0 in oxygen) was found to equal 1.4. The lack of difference in air and oxygen suggests the highly vascularized (oxygenated) gut is maximally sensitive. Animal lethality ($LD_{50(5)}$) is compared with crypt survival. (auth)

6029 EGG PRODUCTION IN HENS CONTINUOUSLY IRRADIATED AS EMBRYOS. Mraz, F. R.; Woody, M. C. (Univ. of Tennessee, Oak Ridge). Radiat. Res.; 54: No. 1, 63-68(Apr 1973).

Fertile White Leghorn eggs were continuously exposed to ^{60}Co gamma rays at 3.4, 1.8, 1.0, 0.9, 0.5, or 0.3 R/hr during incubation for 20 days. The resulting pullets were reared to maturity and their reproductive performance and that of their progeny measured. The continuous administration of 3.4 or 1.8 R/hr during the first 20 days of incubation destroyed all the oocytes in the ovary preventing egg production in the resulting hens. A few hens exposed at rates of 1.0 or 0.9 R/hr during the same period laid a few eggs but stopped within 2 months. After 0.5 R/hr during incubation, a drastic reduction in oocytes was observed, which resulted in sterility in some hens and an inability to sustain egg production in most of the others. Although the hens that received 0.3 R/hr as embryos laid fewer eggs than the controls, little difference in sustained egg production over 11 months was observed. No effect was observed over a 5-month period on egg production from the offspring of dams that received 0.5 or 0.3 R/hr as embryos. (auth)

6030 NUCLEAR VOLUMES, DNA CONTENTS, AND RADIOSENSITIVITY IN WHOLE-BODY-IRRADIATED AMPHIBIANS. Conger, A. D.; Clinton, J. H. (Temple Univ., Philadelphia). Radiat. Res.; 54: No. 1, 69-101(Apr 1973).

The relation of radiosensitivity to nuclear and chromosomal volumes and DNA contents was studied in whole-body-irradiated adult amphibians. Data are presented on liver cell nuclear parameters, volume and DNA contents, per nucleus and per chromosome (NV, ICV; DNA/N, DNA/ch), on correlation of LD_{50} with nuclear parameters, and on mean survival times for a number of species. In a few species, some individuals have detectable polyploid subpopulations in their liver cells. Nuclear and chromosomal volumes (NV and ICV) are linearly related to DNA contents. On the average, for 25 amphibian species an increase of 1.0 μm^3 in nuclear DNA content causes an increase of 17 μm^3 in NV, and residual NV is 72 μm^3 when DNA content goes to zero. It is clear that a large fraction (about 80%) of amphibian NV and ICV is nonchromosomal, i.e., is nuclear "sap." This difference between actual genome size and its estimate as measured by NV may account for some of the difference in radiosensitivity, at the same measured NV or ICV, between amphibians and other higher organisms. Whole-body-irradiated amphibians are very slow to die, requiring 70 to >150 days to complete radiation-induced deaths, with mean survival times (MST) at the LD_{50} of 31 to 190 days. MST increases with increasing nuclear parameter size, but variability is high. Three modes of death (a three-component MST vs dose curve) are apparent. At the minimal LD_{50}, animals die of a hematopoietic death; the mechanism for death at greater doses is not apparent, but is not intestinal damage. LD_{50} decreases with increasing nuclear parameter size, but less rapidly than linearly with a slope of −0.58 for the eight species analyzed (13-fold range of NV). Sensitivity−volume data are available for only two other groups of whole-body-irradiated organisms. At the same ICV, amphibians are about seven times as radiosensitive as herbaceous plants, about three times as sensitive as woody plants. Compared to the four radiosensitivity groups (radiotaxa) found previously among single-cell systems from higher organisms, the correlation of D_0 against ICV for these whole-body-irradiated amphibians falls very close to the D_0−ICV correlation line for the single-cell group that contained amphibians. (auth)

6031 ENZYMATIC CHANGES IN BETA-IRRADIATED EPIDERMIS OF GUINEA PIGS: EXTRACELLULAR AND INTRACELLULAR DEOXYRIBONUCLEASE I. A Correction. Tabachnick, J. (Albert Einstein Medical Center, Philadelphia). Radiat. Res.; 54: No. 1, 163-164(Apr 1973).

It was reported earlier that there was a significant increase in guinea pig epidermal DNase I activity as early as the first day after a dose of 3000 rep beta irradiation from a $^{90}Sr-^{90}Y$ source. Subsequently a ten to twenty fold increase in DNase was found within 24 hr after clipping the hair. In order to separate the effect of clipping from the effect of radiation, areas of the skin were exposed to beta radiation both through the hair and after clipping. Epidermis from which the hair had been clipped immediately prior to irradiation had three to fourfold higher levels of DNase I. It was concluded that there was no significant increment in epidermal DNase activity on the first day following irradiation. (HLW)

6032 SURVIVAL OF DOG KIDNEY ALLOGRAFTS AFTER IN VITRO IRRADIATION. Stevens, L. E. (St. Luke's Hospital Center, New York); Freeman, J.; Warden, G.; Bucko, D.; Steinmuller, D.; Erickson, V. Transplantation; 15: No. 5, 525-526 (May 1973).

A discussion is presented of previous work on survival of irradiated allografts in dogs and rats. In spite of the fact that a wide range of x-ray dosages and histocompatibility combinations were used, it was not possible to demonstrate prolonged graft survival in dogs. A table is presented to show the number of days for onset of rejection of irradiated dog kidney allografts. (HLW)

6033 INHIBITION OF THE GRAFT-VERSUS-HOST REACTION. II. Prevention of Acute Graft-Versus-Host Mortality by Fab Fragments of Antilymphocyte Globulin. Richie, E. R.; Gallagher, M. T.; Trentin, J. J. (Baylor Univ., Houston, TX). Transplantation; 15: No. 5, 486-491(May 1973).

$(C57 \times A)F_1$ mice were lethally irradiated and injected with a mixture of A spleen and bone marrow cells. Mortality caused by acute graft-versus-host disease (GVHD) occurred in all recipients by day 9. Pretreatment of the cell inocula with a preparation of antilymphocyte globulin (ALG) did not enhance recipient survival. When the cell inocula were pretreated with Fab fragments derived from papain-digested ALG, all recipients survived acute GVHD. A dose response effect was indicated by preincubating mixtures of spleen and bone marrow cells with various amounts of Fab fragments. While 0.42 mg of Fab/10^6 cells did not prevent acute GVHD in all receipients, a dose of 0.84 mg of Fab/10^6 cells was capable of reducing recipient mortality to 0% at 15 days. Several of the mice which survived acute GVHD were posttreated with i.p. injections of Fab fragments of ALG in an attempt to reduce the incidence of secondary disease. Preliminary experiments suggest that posttreatment is capable of reducing mortality caused by secondary GVHD. The advantages of pretreating cell suspensions with Fab fragments rather than intact ALG preparations in prevention of GVHD are discussed. (auth)

6034 ROLE OF THE THYMUS IN THE PROLIFERATION AND MIGRATION OF DONOR MARROW CELLS IN IRRADIATED ALLOGENEIC HOST MICE. Takada, A.; Takada, Y. (New York State Dept. of Health, Springville). Transplantation; 15: No. 5, 460-464(May 1973).

CBA/H-T6T6 bone marrow cells (1×10^7) were injected into adult C57BL/6 mice that had received various amounts of radiation. Hosts were either thymectomized or sham thymectomized 10 days before irradiation. Donor marrow cells did not proliferate in the host organs after 400 R of irradiation regardless of thymectomy of the hosts. Donor marrow cells proliferated and comprised more than 65% on day 5 in the spleens and bone marrows of hosts irradiated with 600 R, but were quickly rejected by hosts. Thymectomy of the hosts did not influence the rejection. Donor marrow cells fully repopulated the bone marrows and spleens of hosts irradiated with 800 R by day 10 but not the thymuses or lymph nodes. Donor marrow cells started to appear in the latter organs after day 15, and comprised 100% of the dividing cell population after day 20. The percentages of the dividing cells increased gradually in the lymph nodes of thymectomized and 800 R irradiated hosts. Donor-type cells comprised only 50% of the dividing cell population in the lymph nodes on day 30. These data indicate that rejection of donor marrow cells in host marrows or spleens was a thymus-independent process, but that thymectomy clearly influenced the pattern of donor cell proliferation and migration in irradiated allogeneic hosts. Since allogeneic thymus cells directly settled and divided in the thymuses and lymph nodes of 800 R irradiated hosts, donor marrow cells may have to be modified in their membrane characteristics so that they are accepted in the peripheral lymph nodes. In the absence of the thymus, donor marrow cells that once settled and differentiated in the host marrows later migrated to the lymph nodes. (auth)

6035 PROTECTION BY IMMUNE SPLEEN CELLS AGAINST CHALLENGE WITH MOLONEY SARCOMA VIRUS. Effect of Stage of Donor Response. Pollack, S.; Nelson, K. (Univ. of Washington, Seattle). Transplantation; 15: No. 5, 510-513(May 1973).

Spleen cells from mice with progressing or regressed MSV-induced sarcomas and from normal mice were tested for their ability to protect against MSV in sublethally irradiated syngeneic recipients. This was done because previous in vitro observations showed that both progressor and regressor spleen cells are cytotoxic to Moloney sarcoma cells while sera from progressors but not from regressors can block this cytotoxic effect. On the basis of those observations, it was predicted that in vivo tumor growth would be least vigorous in recipients of regressor cells, intermediate in recipients of progressor cells, and most vigorous in recipients of normal cells. This was found to be the case. The presence or absence of the host's own spleen did not markedly affect the results. (auth)

6036 MYELOID LEUKEMIA: DOES BLOOD LOSS INCREASE THE INCIDENCE IN X-IRRADIATED RATS. Maloney, M. A.; Margulis, A. R.; Patt, H. M. (Univ. of California, San Francisco). Science; 180: No. 4086, 761-762(18 May 1973).

In view of reports by other workers of a greater incidence of myeloid leukemia in x-irradiated rats, an experiment was conducted to attempt to detect a leukemia-triggering effect of blood loss in irradiated rats. Whole-body and partial-body x radiation was administered in 50 and 350 R doses and the rats were bled 1 month later. Myeloid leukemia was not found in any of the rats. (HLW)

6037 TISSUE CHANGES AFTER X IRRADIATION WITH AND WITHOUT COVERINGS BY A PEDICLE SKIN GRAFT. Experimental Investigation. Katzer, H.; Millesi, H.; Kaercher, K. H. (Univ., Vienna). Strahlentherapie; 145: No. 1, 11-15(1973). (In German).

Two fields were labeled on the lower abdominal region of rats. The skin of one field was rotated out of the irradiated field in the form of a lateral pedicle graft during irradiation with a strontium irradiation plate for dermatological purposes. After irradiation, the graft was resewed to the skin. Both fields of skin were examined histologically and the results were compared. It was proved that—in spite of irradiation with one high single dose, restricted to the wound area and imitating the irradiation with fast electrons on a metastasis of inguinal lymph nodes (5,000 rad ^{90}Sr/^{90}Y)—neither histolysis nor fistulation occurred in the subcutaneous and lower tissues, if the wound area was covered by a pedicle graft immediately after irradiation. On the contrary, the fatty and muscle tissue, damaged by irradiation, was gradually substituted under the flap by connective tissue. The results of this experimental investigation prove that severe late sequelae in the healthy tissue can be avoided even if high total doses including megavolt-rays are necessary in critical regions such as axilla and inguen; a precondition is the irradiation planning made by the plastic surgeon and the radiotherapist. (GE)

6038 EFFECTS OF WHOLE-BODY X-IRRADIATION ON ANEMIC MUTANT RATS. Ninkov, V.; Sladic-Simic, D.; Stojanovic, N. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Strahlentherapie; 145: No. 3, 353-356(1973).

The effects of whole-body irradiation were studied in b/b rats, carriers of hypochromic microcytic anemia due to mutation. The b/b rats are extremely sensitive to ionizing radiation, as shown by the lethal effect of doses of 600 R and more, while a dose of 400 R causes death in 90% of the irradiated animals. The irradiated rats die from anemia, as is shown by measurements of hemoglobin concentration in peripheral blood for several days after irradiation. Iron treatment of b/b rats increases their resistance to whole-body irradiation, but this increase was found to be much lower than in corresponding normal animals. (GE)

6039 STIMULATION OF IN VITRO ANTIBODY RESPONSES TO SHEEP RED CELLS BY THYMUS CELLS ACTIVATED TO HISTOCOMPATIBILITY ANTIGENS. Vann, D. C.; Galloway, P. C. (Univ. of Hawaii, Honolulu). J. Immunol.; 110: No. 6, 1542-1553(Jun 1973).

Thymus cells from parental strain mice were injected into γ-irradiated F_1 recipients to produce thymus-dependent (T) cells activated to histocompatibility antigens (ATC). In vitro, the responses of normal spleen cells, expressed as plaque-forming cells (PFC) to sheep erythrocytes, were significantly enhanced by addition of appropriate numbers of ATC reactive with the spleen cell histocompatibility antigens. The enhancement was greatest on day 3 of culture. These effects were observed only when T cells were activated to foreign histocompatibility antigens and the responding spleen cells possessed the histocompatibility antigens to which the T cells were activated. ATC derived from a given strain did not enhance the PFC responses of "bystander" spleen cells that were syngeneic with the ATC unless an appropriate target cell population was added to the culture. Supernatants were prepared that enhanced in vitro PFC responses. The supernatants came from cultures of ATC mixed with target cells. The source and nature of the factor responsible for the enhancing activity have not yet been determined. The mechanism of the enhancement is not known, but it may be related to the observation that addition of ATC or enhancing supernatants to normal spleen cell cultures apparently stimulated cell division to the extent that the normal decline in cell number in primary cultures was eliminated and in some cases recoverable cell counts significantly increased during the 5-day period. (auth)

6040 2-MERCAPTOACETAMIDINE AND DERIVATIVES AS ANTIRADIATION AGENTS. Westland, R. D. (Parke Davis and Co., Ann Arbor, MI); Merz, M. M.; Alexander, S. M.; Newton, L. S.; Bauer, L.; Conway, T. T.; Barton, J. M.; Khullar, K. K.; Devdhar, P. B.; Grenan, M. M. J. Med. Chem.; 15: No. 12, 1313-1321(Dec 1972).

N-Substituted-2-mercaptoacetamidines and functional derivatives, including the corresponding disulfides, Bunte salts, and phosphorothioates, have been synthesized and found as a class to be highly effective antiradiation agents. Antiradiation data for 84 compounds are presented. Survival rates of 90 to 100% in the 30-day test were obtained for many compounds given either ip or po at doses well below toxic levels. Some compounds were extremely potent, being effective at doses below 10 mg/kg ip and below 50 mg/kg po. Sodium hydrogen S-{N-[(3,5-dimethyl-1-adamantyl)methyl]amidino}methyl phosphorothioate given ip resulted in 93% survival at 8 mg/kg and 60% survival at 4 mg/kg (1/31 ip LD_{50}). 2,2′-Dithiobis{N-[(1-adamantyl)methyl]acetamidine} dihydrochloride given po resulted in 80% survival at 50 mg/kg (1/6 po LD_{50}) and 53% at 25 mg/kg. (auth)

6041 ^{14}C-SYNTHESIS, DISTRIBUTION, PLACENTAL TRANSFER, AND FETAL RADIOPROTECTIVE PROPERTIES OF 2,6-di-tert butyl-p-cresol. Shipp, B. D. Lafayette, IN; Purdue Univ. (1972). 135p. University Microfilms Order No. 73-6106.

Thesis (Ph. D.).

The purpose of this research was to study the metabolic patterns of a common food antioxidant 2,6-di-tert-butyl-p-cresol (BHT). A second purpose was to evaluate the possible fetal radioprotective properties of BHT. The study was divided into four sections: the ^{14}C-synthesis of BHT; the time-rate tissue distribution of BHT and/or its metabolites in female rats in the tenth day of gestation; the time-rate placental transfer of BHT and/or its metabolites to rat fetuses in the tenth day of gestation; and the possible fetal radioprotective properties of BHT to rat fetuses exposed to ^{60}Co gamma irradiation in the tenth day of gestation. The synthesis of ^{14}C-BHT involved the introduction of isobutylene into a mixture of p-cresol and ^{14}C-p-cresol with sulfuric acid as catalyst. Reaction conditions investigated were: rate of isobutylene introduction; reaction temperature; reaction time; and percentage of sulfuric acid as catalyst. It was found that a very careful recrystallization from absolute ethyl alcohol (99.6%) and water would give pure crystalline BHT. The final synthesis yielded BHT labeled uniformally in the benzene ring with ^{14}C. The final reported yield was 91.9% with a radiochemical purity of 99+ %. The specific activity of the product was determined to be 0.35 uci/mg. The time-rate tissue distribution of BHT was determined using the ^{14}C-BHT synthesized earlier. The quantity of BHT and/or its metabolites was determined in pregnant albino rats in the tenth day of gestation. It was determined that fat tissue concentrates BHT to the greatest extent. Liver tissue contained the second highest concentration probably due to it being a major metabolic pathway. Kidney, muscle, and blood tissues contained very low concentrations of BHT as compared to that found in fat and liver. The concentration of BHT and/or its metabolites rapidly decreased after the initial maximum readings. Perchloric acid-hydrogen peroxide was chosen as the most desirable digestant of those tested. The time-rate placental transfer of BHT and/or its metabolites to gestational day 10 rat fetuses was also determined using ^{14}C-labeled BHT. Five time periods were investigated; these were 1, 2, 4, 8, and 16 hr post-injection. At the appropriate time periods the fetuses were removed from the maternal animal and the quantity of BHT and/or its metabolites determined. The analysis of this data revealed the absorption and elimination of the BHT and/or metabolites from the fetal tissue. It was found that BHT did cross the placental barrier. The maximum concentration was found to occur between 1 and 2 hr post-injection. The quantity rapidly declined at the later time periods. The efficiency of BHT as a fetal radioprotective drug was determined using ^{60}Co gamma irradiation. Seven groups of pregnant rats in the tenth day of gestation with 10 rats per group were used in the study. Two levels of ^{60}Co irradiation were used. These were 180 R and 200 R. The groups receiving 180 and 200 R exposure were statistically compared to the groups receiving 180 and 200 R exposure and receiving a dose of 150 mg/kg (milligrams of BHT per kilogram body weight) to determine the fetal radioprotective efficiency of BHT. It was found that the percentage of resorptions in the group receiving only 180 R was 48.17% as compared to 18.03% in the group receiving 180 R and 150 mg/kg BHT. The group receiving 200 R exposure resulted in 42.86% resorption with the corresponding value of 49.21% for the group receiving 200 R and 150 mg/kg BHT. There were no anomalies in the groups receiving 180 R. The group receiving only 200 R had 19.05% anomalies as compared to 12.70% in the group receiving 200 R and 150 mg/kg BHT. (Diss. Abstr. Int., B)

6042 RESTORATION OF DELAYED HYPERSENSITIVITY AND ANTIBODY RESPONSE IN IRRADIATED RATS BY NORMAL LYMPHOID CELLS. Visakorpi, R.; Kosunen, T. U. (Univ. of Helsinki). Cell. Immunol.; 5: 369-376(Nov 1972).

Whole-body irradiation with 780 rads suppressed humoral and cell-bound immune responses in rats. Rats were immunized with bovine serum albumin 24 hr after 780 rads and given normal syngeneic lymphoid cells. Lymph node, thoracic duct, or spleen cells were more effective than thymus or bone marrow cells in increasing delayed hypersensitivity responses. Spleen cells (10^7) increased both delayed hypersensitivity and antibody responses. However, with lymph node and thoracic duct cells 10^6 cells increased delayed hypersensitivity but 10^7 or 2.5×10^7 cells were needed to improve antibody responses. Cells from donors tolerant to bovine serum albumin affected neither delayed hypersensitivity nor antibody formation. (auth)

6043 BIOLOGICHESKOE DEISTVIE VNESHNIKH I VNUTRENNIKH ISTOCHNIKOV RADIATSII. (Biological Action of External and Internal Sources of Radiation). Moskalev, Yu. I.; Kalistratova, V.S. Moscow; Meditsina (1972). 356p.

Special features of the reaction of an organism are examined for irregular, instantaneous, short-time, and extended irradiation using Co sources, γ-neutron radiation, and fission neutrons. The biological activity of rare earth and transuranium elements, tritium oxide, ^{90}Sr, ^{137}Cs, and ^{131}I are considered. Eleven papers are devoted to external sources of ionizing radiations and their effects on dogs, rabbits, and rats. A collection of 56 papers are concerned with the effects of incorporated radioactive isotopes on dogs, rats, cattle, and results as extrapolated to man. (KSW)

6044 RADIOSENSITIVITY OF RAT LIVER. Haider, M. (Univ. of Washington, Seattle). Experientia; 29: No. 4, 475-476 (15 Apr 1973).

Exteriorized portions of the rat liver were x-irradiated with the rest of the body shielded. The incorporation of ^{3}H-leucine into Trichloro-acetic acid (TCA) precipitable material was used as a biochemical index of cell viability. No significant effect was detected 1 or 2 days after exposure to doses up to 18 kR. However, incorporation was significantly reduced by 2 days after irradiation at 27 kR or greater doses. Results indicated an extreme radioresistance of hepatic cells to early interphase death. (HLW)

6045 STIMULATION OF CLONOGENIC GROWTH OF TUMOUR CELLS AND METASTASES IN THE LUNGS BY LOCAL X RADIATION. Van den Brenk, H. A. S.; Burch, W. M.; Orton, C.; Sharpington, C. (Saint Thomas' Hospital, London). Brit. J. Cancer; 27: No. 4, 291-306(Apr 1973).

Single cell suspensions of two allogeneic tumors (W-256 and Y-P388) injected intravenously produced macrocolonies in the lungs of rats. Colony forming efficiency (CFE, the number of colonies produced by each viable cell injected) was low in 6-week or older rats but was markedly increased by 1000 to 1500 rad local thoracic irradiation (LTI) given 7 to 14 days before the tumor cell injection, or by antilymphocytic serum (ALS), but not by sublethal whole-body irradiation (WBI). Similarly, LTI increased the incidence of pulmonary metastases produced by a solid tumor growing in the leg muscle. Stimulation of CFE by LTI was a strictly local phenomenon and not due to effects of irradiation on thymus, spleen, or other tissues of the rat. LTI failed to increase CFE in immunized rats. It is concluded that (1) LTI stimulates clonogenic growth of tumor cells arrested in the lungs, by causing inflammatory reactions accompanied by regenerative cellular proliferation of lung tissue, which increases the plating efficiency of tumor cells, and (2) the increase in CFE in lungs is not due to suppression of immunity to tumor growth by LTI. (auth)

6046 INHIBITORS OF MONOAMINE OXIDASE AND THE RADIOPROTECTIVE EFFECT OF 5-HYDROXYTRYPTAMINE. Streffer, C.; Fluegel, M. (Univ., Freiburg i. B.). Int. J. Radiat. Biol.; 23: No. 3, 205-215(Mar 1973).

Monoamine oxidase inhibitors (iproniazid and trans-phenylcyclopropylamine, t-PCPA), injected into mice two hrs before 5-hydroxytryptamine (5-HT), did not alter the maximum radioprotective efficiency of the amine. However, the increased radioresistance of mice was much prolonged under these conditions. This effect was studied in dependence on time of the 5-HT application and on the dose of 5-HT. Iproniazid and t-PCPA provoked a strong inhibition of the monoamine oxidase activity in vivo under the experimental conditions and 5-HT was taken up at a slower rate by the tissue. As a consequence, the level of 5-HT was increased in the tissues for a longer period. From these data it was deduced that metabolites formed from 5-HT via the degradation by monoamine oxidase do not induce or influence the radioprotective effect, and hypothermia caused by 5-HT is not responsible for the increased radioresistance of mice. (auth)

6047 ORIGIN OF CELLS REPOPULATING THE SPLEENS OF IRRADIATED MICE GIVEN MARROW CELLS AND THYMOCYTES. Dehamer, D. L.; Goodman, J. W. (Oak Ridge National Lab., TN). Transplantation; 15: No. 5, 474-477(May 1973).

Augmentation of repopulation was confirmed using mitotic indices of spleens 8 days after injection of bone marrow cells or thymocytes or both, and it was shown that most of the repopulating cells are derived from the donor marrow. Using female rats as bone marrow donors and male rats as thymus donors, and vice versa, we found that 93.1% of the dividing cells in repopulated mouse spleen were of rat bone marrow origin. About 1.0% of the dividing cells were of mouse origin, and 5.9% were derived from rat thymus. (auth)

6048 ANEMIA AND TOTAL LIVER FAT IN THE X-IRRADIATED GARDEN LIZARDS. Banerjee, S. K.; Ghosh, A.; Maity, L. K. (Univ. of Kalyani, India). Curr. Sci. (India); 42: No. 9, 321-322(5 May 1973).

Whole-body x radiation was administered to adult lizards in a 990 R dose. Twenty-four and 72 hr later irradiated and control lizards were killed and erythrocyte count and liver fat were estimated. The average weight of the liver and of the total liver fat in irradiated animals did not differ from that of controls. However, the erythrocyte count dropped significantly at 72 hr after irradiation. (HLW)

6049 HEMOPOIETIC DEFECTS IN MICE INFECTED WITH LYMPHOCYTIC CHORIOMENINGITIS VIRUS. 1. The Enhanced X-ray Sensitivity of Virus Infected Mice. Bro Joergensen, K.; Volkert, M. (Univ. of Copenhagen). Acta Pathol. Microbiol. Scand., Sect. B; 80: 845-852(1972).

Seemingly paradoxical observations were made with mice exposed to infections with the LCM virus and treatment with x rays. The x-irradiation could afford a beneficial effect upon the course of the viral infection or cause a serious aggravation. The beneficial effect was associated with x-ray treatment given prior to the inoculation of virus. This pre-irradiation effectively prevented an antiviral immune response and protected mice against lethal intracerebral challenges with the virus. However, doses of x rays which were sublethal in normal mice provoked a lethal disease when given to mice previously inoculated with the virus. Fatal outcomes were observed with persistent, tolerant virus carriers and with i.p.-infected adult mice, that is, in cases of normally inapparent LCM virus infections. The x-ray-induced deaths were apparently not related to any enhanced growth of the virus in the irradiated mice. Clinical findings and reconstitution experiments strongly indicated that the striking increase in the sensitivity to x rays was caused by a haemopoietic defect in the LCM-virus-infected mice. The nature of this haemopoietic disorder is not readily explained. Thus several observations made it unlikely that the LCM virus had any direct damaging effect upon the haemopoietic cells. Moreover, the findings with the persistent, tolerant virus carriers provided evidence against any immunopathological basis of the disorder. (auth)

6050 CHANGES IN THE RATE OF REPOPULATION DURING MULTIFRACTION IRRADIATION OF MOUSE SKIN. Denekamp, J. (Royal Postgraduate Medical School, London). Brit. J. Radiol.; 46: No. 545, 381-387(May 1973).

The skin reaction on the feet of albino mice was used to investigate the relative effects of repopulation and repair of sublethal injury at various stages during a course of daily 300 rad x-ray fractions. Previous two-dose experiments have shown that with increasing time after a priming dose of 1,000 rads, additional dose is needed to produce a given skin reaction. Five hundred rads were required after the first 24 hours, whereas only 30 rads per day were needed to counteract the subsequent repopulation. In the present series the average dose increment that was required between 4 or 9 daily fractions was almost 200 rads per interval, and was not attributable to repopulation. Between the 9th and 14th fractions this average dose increment increased because of a contribution from an increased rate of repopulation. After 4 fractions there was no measurable repopulation for two weeks. After 9 fractions approximately 50 rads per day were needed to counteract repopulation. After 14 fractions approximately 130 rads per day were needed for the first week, falling to about 20 rads per day in the second week. 130 rads per day corresponds to a doubling time of about 18 hours for the basal cells of the epidermis, which could then repopulate the damaged tissue in approximately one week. (auth)

6051 GAMMA-RADIATION OF HEART VALVES AT 40°C. A Comparative Study Using Techniques of Histochemistry and Electron and Light Microscopy. Donnelly, R. J.; Aparicio, S. R.; Dexter, F.; Deverall, P. B.; Watson, D. A. (Univ. of Leeds, Eng.). Thorax; 28: No. 1, 95-101(Jan 1973).

Pig aortic valve cusps were studied using techniques of histochemistry, light microscopy, and electron microscopy, and the effects of gamma radiation at 4°C were determined. The effects of freezing, β-propriolactone, and freeze-drying were also studied. Gamma radiation at 4°C and storage at this temperature in a polyionic environment for up to six weeks appeared to have minimal adverse effects. This technique of sterilization and storage has now been used in a clinical valve programme for over two years with encouraging results. (auth)

Invertebrates

6052 UV DAMAGE AND ITS PHOTOREACTIVATION DURING THE EARLY DEVELOPMENTAL STAGES OF THE SILKWORM

EGG. Takizawa, Y.; Yoshida, H. (Hokkaido Univ., Sapporo). Nippon Sanshigaku Zasshi; 41: No. 1, 21-27(Feb 1972). (In Japanese).

Ultraviolet sensitivities with special reference to variations in killing and mutation were studied at various phases from the first meiotic stage to the early cleavage stage of the eggs after oviposition. After these eggs were irradiated with varying doses of uv, embryonic mortality and mutation frequency at egg-color specific loci were measured. Photoreactivating effects to both uv-damage were studied at each stage by post-treatment with visible light. The percentages of killing and mutation induced by uv in the first meiotic stage were remarkably decreased by the photoreactivating light. When the eggs were irradiated after the first meiotic division, uv-induced mutation frequency was extremely lower. After the first meiosis, the nucleus then migrates to the inner part of the egg. Consequently, uv light cannot penetrate to the nucleus after the first meiotic stage. Thus killing effects after this stage seem to be due to the periplasmic lesions. These killing effects could not be photoreactivated. The frequency of fractional-body mutation induced by uv at the first meiotic stage was higher than that of whole-body mutation. The former was more likely to be repaired by photoreactivating light than the latter. These findings seem to suggest that fractional-body mutation induced by uv may be caused by changes in one of the double-strand of the gene DNA and that whole-body mutation by changes in both. (auth)

6053 EFFECTS OF ULTRAVIOLET LIGHT ON THE EARLY EMBRYOS OF THE SILKWORM AND ITS BIOLOGICAL SIGNIFICANCE. Murakami, A. (National Inst. of Genetics, Mishima, Japan). Dobutsugaku Zasshi; 81: No. 1, 41-48(Jan 1972). (In Japanese).

To analyze the relationship betwcen uv sensitivity and embryonic development, an experiment was carried out using synchronized cell populations during early embryogenesis of the silkworm. A marked change of uv sensitivity was observed with the progress of embryonic development. Sensitivity to uv was relatively low in the first 10 hours after oviposition, and then it gradually increased with the age of the eggs. From 10 hours on after the oviposition, an extremely high sensitivity was observed. Photoreactivation of uv damage was more effective for eggs in uv sensitive stages than for those in resistant stages. In addition, no cyclic change of uv sensitivity in eggs during early cleavage stages (from 200 to 400 min after oviposition) was observed in accordance with the division cycle, in spite of a cyclical change in sensitivity to ionizing radiation during cleavage of the silkworm. This suggests that injury to the nuclei in early stages are not responsive to uv killing of the embryos because the nuclei are protected by the cytoplasm. Although the cytoplasm per se was not so sensitive to uv, the death of cleaving eggs may be attributable, in part, to the cytoplasmic injury caused by its direct exposure to uv. This suggestion might be relevant to the observation that the cytoplasm is able to repair its damage induced by ionizing radiation. (auth)

6054 INFLUENCE OF IONIZING RADIATION ON REPRODUCTION AND MORTALITY OF THE FLOUR MITE (ACARUS SIRO L.). Jonczy, J. (Jagellonian Univ., Krakow). Folia Biol. (Krakow); 21: No. 1, 77-84(1973).

Eggs and populations of the flour mite (Acarus siro L.) were irradiated with soft x rays and gamma rays. Doses up to 100,000 R of x rays had no visible effect on populations whereas a dose of 60,000 R inhibited hatching of the treated eggs completely. The following lethal and sterilizing doses of gamma radiation were determined for eggs and whole populations: lethal dose for eggs, 20,000 roentgens; absolute lethal dose (ALD) for population, 200,000 R within 15 days, 150,000 R within 30 days, 100,000 R within 60 days; sterilizing dose for eggs, 10,000 R (individuals that hatched from eggs exposed to this dosage were sterile); and sterilizing dose for population, 60,000 R. Low dosages, up to 5,000 R of x-rays and 2,000 R of gamma rays, had a stimulating influence on eggs and populations of the flour mite. (auth)

6055 EFFECTS OF CHRONIC ^{60}Co (GAMMA) RADIATION, DOSE RATE, TEMPERATURE, AND COHABITATION ON POPULATION PERFORMANCE OF FLOUR BEETLES. Erdman, H. E. (Battelle Pacific Northwest Labs., Richland, WA). Environ. Entomol.; 2: No. 1, 41-48(Feb 1973).

This investigation concerned the population dynamics and the possible control of Tribolium confusum Jacquelin duVal and T. castaneum (Herbst) subjected to chronic irradiation. At 3 dose levels of ^{60}Co gamma radiation (24, 49, and 170 R per day) 5 replicate populations of single species (20 pairs in each) and of mixed species (10 pairs of each species) were established in 5 g of food in lucite test tubes. Larvae, pupae, and adults were counted monthly and along with eggs were transferred to new food. Culture conditions were 25 and 32°C in 70 to 75% relative humidity. In general, at 25°C the single-species reproductive performance, measured as the number of larvae and adults, was impaired by exposure to radiation. Poorest performance appeared at 170 R per day; whereas, 24 and 49 R per day resulted in reduced, but comparable productivity. Larvae were more radiation-sensitive than adults. Numbers of adults reached zero more slowly than larvae at 170 R per day, indicating no adult replacement. Results were accentuated at 32°C. Responses to radiation of mixed- and single-species populations were comparable at 25°C. There was greater survival of larvae and adults in mixed-species populations at 32°C than at 25°C. Data from this experiment showed that 170 R per day dose rate was sufficient to stop larval development; but 49 R per day was not enough to eliminate flour beetle populations. The radiation effects on population performance were attributed to induced genetic aberrations rather than to physiological impairment. The feasibility of implanting radiation sources in a grain storage facility to control insects is discussed. (auth)

6056 RADIOSENSITIZING PROPERTY OF BUTYLATED HYDROXYTOLUENE IN DROSOPHILA SPERM. Kamra, O. R. (Dalhousie Univ., Halifax, Nova Scotia). Int. J. Radiat. Biol.; 23: No. 3, 295-297(Mar 1973).

Seven day old males of Drosophila melanogaster were injected with 0.2 μl of 0.001 or 0.0001 of butylated hydroxytoluene in physiological saline. When fully active and within two hours of injection, they were exposed before mating to 2.4 Krads γ rays from a ^{137}Cs at 4.12 rads/sec. Although found to be non-mutagenic by itself, BHT proved to be an extremely effective radiosensitizer of the γ-induced sex-linked recessive lethal mutations and chromosome translocations. No discernible changes in the sex-ratio, incidence of XO males of XXY non-disjunction females was observed. The effect observed appeared to be strongly dependent on concentration, though both concentrations used were significant in inducing radiosensitization. It is suggested that the radiosensitizing and potential mutagenic properties of food additives should be further investigated. (UK)

6057 EFFECTS OF GAMMA RADIATION ON THE ADULT STAGE OF THE LESSER COTTON LEAF WORM, SPODOPTERA EXIGUA (Hb). Wakid, A. M.; Ahmed, M. Y. Y. (Atomic Energy Establishment, Inshas, Egypt). Z. Angew. Entomol.; 71: No. 4, 355-359(1972).

Moths of the lesser cotton leaf worm, Spodoptera exigua Hb. were exposed to a wide range (20 to 100 krad) of gamma radiation. Egg production was decreased by increasing the dose of exposure. Egg fertility was affected by low doses (20 krad) when treated females were mated to normal or treated males. Normal females mated with treated males produced few viable eggs at 50 krad. Adult longevity was not affected by gamma radiation up to 50 krad above which the female longevity began to decrease. (GE)

6058 CYTOLOGICAL ANALYSIS OF LETHALS, ARISING AT VARIOUS STAGES OF SPERMATOGENESIS OF DROSOPHILA UNDER THE PREPARATION F-11. Eliseeva, K. R.; Mase, I. B.; Rakitski, P. F. (Inst. of Genetics and Cytology, Minsk). Vestsi Akad. Navuk BSSR, Ser. Biyal. Navuk; No. 2, 37-42(1973). (In Belorussian).

A cytological study of recessive lethals obtained in Drosophila as a result of the joint action of x radiation and the indene derivative F-11 (not completely identified) showed that a change in the genetic sensitivity to radiation of postmeiotic cells occurred in large measure on account of a change in the frequency of chromosomal aberrations. At the mature sperm stage, in which the preparation increased the sensitivity to radiation of the cells, there was observed an increase in the percent of chromosomal aberrations among lethals in comparison with the controls. At the spermatid stage, where a protective effect was detected, a significant decrease in the percent of chromosomal aberrations was observed. The percent of lethals that had a cytologically normal X-chromosome was altered to a lesser degree. In the pre-meiotic cells a protective effect was manifest on account of cytologically undetected lethals. (tr-auth)

6059 STUDIES ON SURRA. VII. Effect of Irradiation (Gamma Rays) on Trypanosoma Evansi. Gill, B. S.; Sokolic, A. (Indian Veterinary Research Inst., Izatnagar). Indian J. Anim. Res.; 41: No. 9, 835-839(1971).

The effect of γ rays on T. evansi was investigated. It was found that irradiation up to 9.5 kR did not affect infectivity of the trypanosomes. Irradiation at 10 and 10.5 kR reduced infectivity to 70 and 10%, respectively, while higher doses abolished infectivity altogether. Out of 224 rats, 24 became infected with irradiated trypanosomes and developed relapsing type of infection. This altered behavior of the trypanosome was not due to lowered virulence of the parasite. The discontinuous course of the infection could possibly have been due to the development of immunity consequent to inoculation of irradicated trypanosomes. The prevalent temperature at the time of irradiation had significant effect on the infectivity of trypanosomes. This effect was directly proportional to the temperature. (Indian Science Abstracts)

Radionuclide Effects (Internal Source)

Refer also to abstract 5535.

6060 TITRATION AND SUBUNIT LOCALIZATION OF ACTIVE CENTER CYSTEINE IN FIBRINOLIGASE (THROMBIN-ACTIVATED FIBRIN STABILIZING FACTOR). Curtis, C. G.; Stenberg, P.; Chou, C. H. J.; Gray, A.; Brown, K. L.; Lorand, L. (Northwestern Univ., Evanston, IL). Biochem. Biophys. Res. Commun.; 52: No. 1, 51-56(1 May 1973).

Fibrinoligase activity, measured in a fully synthetic substrate system, was shown to be inhibited by prior incubation of the enzyme with iodoacetamide. Using 1-^{14}C-iodoacetamide, the amount of incorporated radioactivity increased in proportion to the loss of enzyme activity. Labelling of the enzyme was totally dependent on the addition of calcium ions and, under the conditions described, occurred predominantly in the a′ protomer. Acid hydrolysis of labelled fibrinoligase gave rise to S-carboxymethylcysteine as the only radioactive amino acid derivative. (auth)

Man

Refer also to abstracts 5525, 5530, and 6463.

6061 (FRNC-CONF-63) BIOPHYSICS OF SYNOVIOMATHESIS USING β EMITTING ISOTOPES. Roucayrol, J. C. (Hopital Cochin, Paris (France)). 1971. 6p. (In French). (CONF-710563-6). Dep. NTIS (U. S. Sales Only).

From meeting on radioisotope synoviotherapy (synoviomathesis); Paris, France (26 May 1971).

The various factors determining the biological effects of irradiation encountered in synoviorthesis are reviewed. The use of colloidal β emitters is preferred to that of soluble α emitters. If the migration of these products can not be avoided, tracer doses are given in order to determine the treatment to be effected. (FR)

6062 (FRNC-CONF-65) INTRA-ARTICULATORY INJECTION OF RADIOACTIVE COLLOIDS. Studies with Animals. Bonneton, C. (Institut National de la Sante et de la Recherche Medicale, Paris (France)). 1971. 6p. (In French). (CONF-710563-1). Dep. NTIS (U. S. Sales Only).

From meeting on radioisotope synoviotherapy (synoviomathesis); Paris, France (26 May 1971).

The changes in the intra-articulatory distribution of Er and Re colloids were examined as a function of time using autoradiography and autohistoradiography. The radioactive colloids studied remained in the region into which they had been injected with a preferential localization around the synovial membranes. Intra-articulatory injection of these products into healthy animals did not produce any functional troubles. The presence of these products did however produce some modifications in the histological characteristics of the synovial tissue. (France)

6063 (IRS-W-5) PARAMETERS TO BE CONSIDERED WHEN CALCULATING THE AGE-DEPENDENT ^{131}I DOSE TO THE THYROID. Hoffman, F. O. (Technischer Ueberwachungs Verein E. V., Cologne (West Germany). Institut fuer Reaktorsicherheit). Apr 1973. 33p. Dep. NTIS (U. S. Sales Only) $3.75.

An effort is made by means of a literature survey to specify age dependency within the thyroid dose parameters involved with ingestion or inhalation of elemental ^{131}I. For calculating thyroid doses, age-dependent values are recommended for thyroid mass, the biologically effective energy per disintegration of ^{131}I in the thyroid, the effective half-life of ^{131}I in the thyroid, the inhalation retention factor, the fractional uptake of deposited or ingested iodine and the rates of inhalation and fresh milk ingestion. From these recommended values the age-dependent inhalations and ingestion dose factors are derived. (auth)

6064 LATE THOROTRAST RADIATION INJURIES. Bauer, R. (Univ., Tuebingen, Ger.). Aerztl. Forsch.; 26: No. 10, 322-344(10 Oct 1972). (In German).

The symptoms of Thorotrast damage especially those detected by x-rays, are described, including rare forms of this disease. The physical and biological aspects of the Thorotrast effects are discussed. The alpha radiation is particularly dangerous due to its high relative biological effectiveness. The advantages of Thorotrast in x-ray diagnosis, which are described, led to its extended use for several decades in spite of early warnings. A central registration and continuous observation of all former Thorotrast patients is proposed. (HLW)

6065 RISKS TO MAN AND HIS ENVIRONMENT FROM RADIATION SOURCES. Jammet, H. (CEN, Fontenay-aux-Roses, France). pp 83-87 of Disposal of Radioactive Waste. Paris; Organisation for Economic Co-operation and Development (1972). (In French and English).

From meeting on disposal of radioactive waste; Paris, France (12 Apr 1972). See CONF-720453-.

The harmful radiological effects and the risks arising from radioactive waste disposal are considered. The main characteristics of exposure to radiation from radioactive wastes are: internal rather than external radiation exposure; continuous low-dose-rate radiation exposure; and exposure from radiation with RBE = 1 with certain exceptions. The radiological risks include both somatic and genetic injuries. The carcinogenic effects include leukemia and various cancers. The hereditary effects include genetic mutations and chromosome aberrations. At present and within a foreseeable period of time, radiological risks from radioactive wastes may be considered negligible. (ERB)

6066 LOCATION-DEPENDENT SPECIFIC DOSE OF ^{131}I. Bayer, A. (Kernforschungszentrum, Karlsruhe, Ger.). Atomwirt., Atomtech.; 18: No. 1, 31-32(Jan 1973). (In German).

The considerations are based on the most modern proposal of the German Atomic Energy Commission that limits the thyroid burden of small children to 90 mrem/y of ^{131}I. This limit demands that the emission of one or several adjacent installations may not exceed 2 Ci ^{131}I per year, whereby a maximum of 1 Ci may be emitted during the season of pasture feeding. (tr-auth)

6067 CONCENTRATIONS OF URANIUM IN THE AIR OF A URANIUM REFINERY AND IN URINE OF THE WORKERS. Okabayashi, H.; Hiki, M.; Watanabe, S.; Hongo, S.; Suzuki, M. (National Inst. of Radiological Sciences, Chiba, Japan). Hoken Butsuri; 7: No. 3, 151-155(Sep 1972). (In Japanese).

With the development of peaceful uses of atomic energy, the facilities dealing with uranium compounds have recently increased. In the uranium refinery, there are several uranium compound dusts in the air and workers there may encounter inhalation hazards. The concentrations of uranium in the air of a uranium refinery and in the urine of the workers were measured. Uranium was found to be in the range of 9.6×10^{-11} to 3.7×10^{-9} g/l in the air of the refinery and, in the range of 3.9×10^{-7} to 3.6×10^{-6} g/l in the urine of the workers. The concentration in the air was higher than that of natural level by an order of two to four and that in the urine was higher than that in the general public. It is considered that these high levels in the urine are due to inhalation of higher concentrations of air borne uranium in the working environment. (auth)

6068 HEMOGLOBIN OF RED CELL STROMATA FROM MINERS OF URANIUM MINES. Nosek, J.; Pehr, F. (Inst. of National Health in Uranium Industry, Pribram, Czech.). Rev. Czech. Med.; 18: No. 2, 65-70(1972).

The amount of stromata-bound haemoglobin in the erythrocytes of uranium miners was studied. The miners were divided into five groups according to the time they had worked underground. As against the controls, as much as 16% of stromata-bound haemoglobin was found in the erythrocytes of the miners. A significant increase was found in the group of miners who had worked underground for five to seven years. Significant differences were also found between the respective groups of miners. The amount of stromata-bound haemoglobin was found to increase over the first six years of work underground and then to decrease slowly below the control value. The results were compared with the change in the average turnover rate of methaemoglobin in vitro. The curve of the methaemoglobin turnover was found to be proportional to the changes in the amount of haemoglobin bound to the stromata of the erythrocytes of uranium miners. (Nucl. Sci. Abstr. Czech.)

Animals

Refer also to abstract 6043.

6069 (BNWL-SA-4487) MINICOMPUTER CONTROL OF AEROSOL INHALATION EXPOSURES. Dionne, P. J.; Craig, D. K.; Decker, J. R. (Battelle Pacific Northwest Labs., Richland, Wash.). 1973. Contract AT(45-1)-1830. 14p. (CONF-730508-1). Dep. NTIS $3.00.

From 6th. conference on minicomputers and their applications; Honolulu, Hawaii, USA (2 May 1973).

The range of radiation doses received by dogs following inhalation of $^{239}PuO_2$ aerosols differed from the desired dose by more than an order of magnitude. This wide range was attributed to variations in individual dog characteristics, aerosol concentration, length of exposure, and other variables. Incorporation of tidal volume air monitor (TVAM) and a plutonium aerosol monitor (PAM) into the inhalation exposure system reduced the range to a factor of three for 74 percent of the desired dose. Connecting a minicomputer to the TVAM and PAM allows a breath-by-breath analysis to be made, thus reducing the range even further. The cost of the computer ($15,000) is more than offset by the reduction in data analysis and animal maintenance costs. More importantly, use of the computer will assure good long term results. (auth)

6070 (BNWL-SA-4659) CARCINOGENICITY OF INHALED PLUTONIUM-238 IN THE RAT. Sanders, C. L. Jr. (Battelle Pacific Northwest Labs., Richland, Wash.). 1972. Contract AT(45-1)-1830. 40p. (CONF-730603-2). Dep. NTIS $4.00.

From 18th Health Physics Society meeting; Miami Beach, Florida, USA (17 Jun 1973).

Three groups of albino, female rats were exposed to an aerosol of soluble ^{238}Pu derived from crushed $^{238}PuO_2$ microspheres suspended in physiological saline. Initial alveolar burdens of ^{238}Pu were 5 nCi (Group I), 18 nCi (Group II), and 230 nCi (Group III). Only 1% of the initial alveolar lung burden remained in the lung at one year, decreasing to 0.3% by 600 days after exposure. The ^{238}Pu body burden was 25% of initial alveolar burden at one year, decreasing to 12% by 1,000 days after exposure; about half of the body burden was found in the skeleton at these times. The cumulative radiation doses to the lung at two years after exposure were 9 rads (I), 32 rads (II), and 375 rads (III). Unexposed controls exhibited a median survival time of 825 days as compared to experimental survival times of 650 days (I), 675 days (II), and 550 days (III). The incidence of lung tumors in controls was 1.1% as compared to incidences in ^{238}Pu exposed rats of 6.6% (I), 23.3% (II), and 25.0% (III). The incidence of all tumors, other than mammary tumors, was 4.3% in unexposed controls, and in ^{238}Pu exposed rats, 26.7% (I), 36.6% (II), and 46.8% (III). It was concluded that exposure of rats to small amounts of inhaled ^{238}Pu resulted in a significant incidence of tumors in the lung and other tissues. (auth)

6071 EFFECTS OF CHRONIC ENVIRONMENTAL RADIATION ON A NATURAL POPULATION OF THE AQUATIC SNAIL PHYSA HETEROSTROPHA. Cooley, J. L. (Oak Ridge National Lab., TN). Radiat. Res.; 54: No. 1, 130-140(Apr 1973).

A natural population of the aquatic snail Physa heterostropha was studied in an area where the snails were exposed to chronic environmental radiation of approximately 0.65 rad/day. Fecundity levels of the irradiated population and a control population were compared in the field and in the laboratory. When compared to the control population, the frequency of egg capsule production in the irradiated population was reduced. However, egg production by both populations was similar because the irradiated population produced an increased number of eggs per capsule. The increased number of eggs per capsule was possibly a compensation for the reduced capsule production and was brought about by natural selection. (auth)

Nuclide Kinetics and Toxicology

Man

Refer also to abstracts 5574, 6066, and 6068.

6072 CLASSIFICATION OF RADIOISOTOPE WORKERS. Evans, H. D. (Imperial Coll. of Science and Tech., London). Health Phys.; 24: No. 5, 562-564(May 1973).

It is stated that the legislation and codes are remarkably inexplicit on criteria governing the division between classified and non-classified employment for persons handling unsealed radioactive substances. It is suggested that the criteria used should be the maximum permissible annual intake (MPAI) which is the amount of a radionuclide taken into the body that delivers one annual dose limit to the critical organ. The magnitude of the amount varies with route of entry and formulae for entry by ingestion, inhalation, and direct entry into the bloodstream are given. It is proposed that the dividing line between classified and non-classified workers handling unsealed radioactive materials should be set at the lowest MPAI for the nuclide in use, rounded up or down to the nearest whole number in conformity with ICRP practice. Where more than one radionuclide is in use at any one time, the sum of the fractions of an MPAI for each of the nuclides concerned, should not exceed unity. If, however exposure of the hands to β-particles is likely, the maximum quantity should be 100 μCi (1 mCi for β-emitters of $E_{max} < 0.3$ MeV) if this is less than the MPAI. (UK)

6073 RADIOACTIVITY IN DEER ANTLERS AND HUMAN STRONTIUM-90 UPTAKE. Gelbke, W. (Univ., Goettingen, Ger.). Z. Tierphysiol. Tierernaehr. Futtermittelk.; 29: 178-195(29 May 1972). (In German).

Strontium-90 is primarily stored in the skeleton following ingestion by men or animals. The long-term course of this reaction can be particularly well followed in the case of deer antlers since these grow and are shed annually. Individual variations are insignificant when considering the annual series of antlers. In 108 antlers from 16 deer, coinciding patterns for the ^{90}Sr content from 1947 to 1969 were found. These values differ by a maximum factor of 5.8 for animals living on lime-rich and lime-deficient soils. Climatic and orographic conditions also have an effect on the values determined. The pattern of ^{90}Sr accumulation clearly demonstrates a correlation between the emission of fission products from nuclear explosions in the atmosphere. Numerical values can be determined either for the delayed appearance of extreme values or for the leveling off. An analysis of the relevant storage effects (atmosphere, soil, incorporation by plant and animal) is not possible. However, parallel measurements of antler and skeletal material from three deer show that ^{90}Sr previously deposited in the skeleton partakes in the development of new antlers. There exists a considerable parallelism between the amount of ^{90}Sr in the human skeleton and that in deer antlers. This fact allows a reverse extrapolation with respect to time. (auth)

6074 UPTAKE OF ^{87m}Sr BY LIVER METASTASIS FROM CARCINOMA OF COLON. Chaudhuri, T. K.; Chaudhuri, T. K.; Go, R. T.; Taube, R. R.; Christie, J. H. (Univ. of Iowa, Iowa City). J. Nucl. Med.; 14: No. 5, 293-294(May 1973).

In a patient with a metastatic lesion in the liver from a primary carcinoma in the colon, a ^{87m}Sr whole-body scan revealed excessive accumulation of isotope within the liver lesion. This uptake of ^{87m}Sr in the liver metastasis cannot be attributed to increased vascularity of the tumor as evidenced from the absence of activity in the ^{113m}In-transferrin scan. The possibility of specific tumor uptake of ^{87m}Sr (as with gallium) has to be kept in mind. (auth)

6075 ^{99m}Tc-PERTECHNETATE TRANSPORT IN MAN: ABSORPTION AFTER SUBCUTANEOUS AND ORAL ADMINISTRATION; SECRETION INTO SALIVA AND GASTRIC JUICE. Hays, M. T. (Veterans Administration Hospital, Buffalo). J. Nucl. Med.; 14: No. 6, 331-335(Jun 1973).

Fifteen normal subjects were studied in multiple sessions after administration of $^{99m}TcO_4^-$ by the oral, subcutaneous, and intravenous routes. Using plasma radioactivity after intravenous administration as the norm for 100% absorption, subcutaneous $^{99m}TcO_4^-$ was absorbed promptly with 95% or more absorption occurring 45.8 ± 22.7 (s.d.) min after injection. Orally administered $^{99m}TcO_4^-$ was erratically absorbed with marked variability in the timing and extent of absorption. This variability occurred between subjects and between sessions in a single subject. The addition of human serum albumin to bind the oral $^{99m}TcO_4^-$ did not significantly affect absorption. Six patients with gastrointestinal disease were studied for absorption of oral $^{99m}TcO_4^-$ and for quantification of $^{99m}TcO_4^-$ and ^{131}I transfer into the saliva and gastric juice after intravenous administration. Gastric juice pH did not affect absorption of oral $^{99m}TcO_4^-$. Gastric juice/plasma (G/P) and saliva/plasma (S/P) ratios were greater for ^{131}I than for $^{99m}TcO_4^-$ in all instances when measured simultaneously. (auth)

6076 CLINICAL INVESTIGATION OF THE KINETICS OF RADIOIODINE AND THE BIOLOGICAL HALF-LIFE OF ORALLY ADMINISTERED ^{131}I. Luetgemeier, J.; Ludwig, P.; Hebestreit, H. P. (Heidelberg Univ., Mannheim, Ger.). Fortschr. Geb. Roentgenstr. Nuklearmed.; 11: No. 93, 325-329(1973). (In German).

Data regarding the exchange of ^{131}I between plasma and extrathyroid compartments are inadequate. Retention in various organs, as well as the thyroid, has been measured for short periods of time only. One hundred and one patients (including 21 with hyper- and 10 with hypothyroidism were examined and organ and serum activity and urinary excretion were determined over a period of six weeks. The half-life was calculated for the individual compartments, in order to express the complexities of radioiodine metabolism adequately. (GE)

6077 IMAGING OF BONE METASTASES WITH ^{99m}Tc–Sn-EHDP (DIPHOSPHONATE), ^{18}F, AND SKELETAL RADIOGRAPHY. A Comparison of Sensitivity. Silberstein, E. B.; Saenger, E. L.; Tofe, A. J.; Alexander, G. W. Jr.; Park, H. M. (Univ. of Cincinnati). Radiology; 107: No. 3, 551-555(Jun 1973).

Skeletal scintigraphy employing a new technetium-labeled diphosphonate compound (^{99m}Tc–Sn-EHDP) was compared with fluorine-18 bone scanning and radiographic skeletal survey to determine its ability to detect metastatic lesions. Fluorine-18 scanning revealed only 56% of the lesions seen with ^{99m}Tc–Sn-EHDP while the latter detected all lesions seen with fluorine-18 scanning. In the 10 patients studied, only 1 of 60 metastases was missed with ^{99m}Tc–Sn-EHDP, while skeletal radiography failed to visualize 43 of the 60 lesions. (auth)

6078 DISAPPEARANCE OF RADIOACTIVITY FROM PLASMA FOLLOWING INTRAVENOUS ADMINISTRATION OF TRITIATED THYROTROPHIN-RELEASING HORMONE (Ro 8-6270) TO MAN.

Dixon, R.; East, S.; Buckley, M.; Darragh, A. (St. James's Hospital, Dublin). Experientia; 29: No. 4, 483-484(15 Apr 1973).

Tritium-labeled TRH was injected intravenously into four human subjects. Aliquots of plasma and urine were assayed for tritium activity at intervals up to 6 hr. The plasma concentrations declined bi-, exponentially and were fitted, by means of a digital computer program, to an equation. The initial fast disposition phase had a half-life of about 10 min followed by a slower disappearance with a half-life of 3 hr. Of the total radioactive dose, 70 to 78% was excreted in the urine within 24 hr after administration. (HLW)

6079 CHEMISTRY OF PLUTONIUM INCORPORATED INTO HUMANS. Popplewell, D. S. (National Radiological Protection Board, Harwell, Eng.). Radiol. Prot. Bull.; No. 3, 13-16(Apr 1973).

A brief review is presented of work by the National Radiological Board on the chemistry of plutonium incorporated in the body. The subject is dealt with in outline under the following headings: transport within the body in relation to the use of chelates especially Ca-DTPA; studies of transferrin complexes in body fluids and comparison with americium-transferrin complexes; intracellular uptake in liver; removal of the liner including studies of chelates more lipid soluble than Ca-DTPA, in conjunction with glucan which proved too toxic for human use; and deposits in the bone. No literature references are given. (UK)

Animals

Refer also to abstracts 5568 and 5575.

6080 (RLO-2227-T-12-36) TURNOVER OF ^{65}Zn IN OYSTERS. Cutshall, N. (Oregon State Univ., Corvallis (USA). School of Oceanography). 1972. 19p. Dep. NTIS $3.00.

The uptake and loss of ^{65}Zn by Pacific oysters are fitted by first-order exponential equations. The rate constants determined from loss are not different from rate constants determined from uptake. The same rate constants can be used to relate steady-state concentration factors for ^{65}Zn to concentration factors for stable zinc. First-order exponential equations adequately fit available data. Potential experimental difficulties in fitting first-order equations arise when uptake times are short. (auth)

6081 EXCRETION AND DISTRIBUTION OF ^{144}Ce IN THE RAT FOLLOWING DIFFERENT ROUTES OF ADMINISTRATION. Takada, K.; Fujita, M. (Japan Atomic Energy Research Inst., Tokai). Hoken Butsuri; 7: No. 3, 135-139(Sep 1972). (In Japanese).

Urinary and fecal excretion of ^{144}Ce was studied for 15 days following subcutaneous, intramuscular, intraperitoneal, and intravenous injection of ^{144}CeCl$_3$ to the rat. From the third to the 15th day, the daily urinary excretion of ^{144}Ce following all the routes of administration was expressed in the first approximation by a single exponential function, regardless of the routes. It means that the initial body burden of ^{144}Ce can be estimated from the daily urinary excretion of ^{144}Ce during this period using an identical formula. Tissue distribution of ^{144}Ce 15 days postinjection was also studied. After 15 days following subcutaneous and intramuscular injection, 57 and 38% of the injected ^{144}Ce were found at the sites of injection, respectively. The transported ^{144}Ce was deposited mainly in the liver and bone regardless of the routes of administration. (auth)

6082 CONTAMINATION OF ANIMALS AND ANIMAL PRODUCTS WITH RADIOACTIVE FALLOUT. Danbara, H. (National Inst. of Animal Industry, Chiba, Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 577-580(Apr 1972).

Since the nuclear detonation test at Bikini Atoll in 1954, many investigations have been made regarding fallout problems in the field of livestock. Though no radioactivity was found in marketed feed and wild grass hay at the time, the relationship of ^{90}Sr content between feed and milk has been observed. The transfer of radioactive elements into milk, eggs, and fetuses of farm animals was investigated. As for the ^{90}Sr, the transfer was suppressed when administered with a large amount of Ca. As for the excretion of ^{89}Sr from cows, 38%, 3.4%, and 7.8% of the dose were found in feces, urine, and milk, respectively. Excretion of the ^{90}Sr disappeared about 30 days after administration. About 3% of the dose of ^{131}I was found in eggs on the 4th day after administration. Though egg albumin was higher in the amount of ^{131}I than egg yolk one day after the administration, a reversed relationship was observed two days after the administration. A gross survey on the content of radioactive fallout nuclides in animal products has been made since 1954, but ^{90}Sr, ^{137}Cs, and ^{131}I have been analyzed routinely since 1957. Milk is a very important food for babies, because its Ca content is higher than that of cereal crops. There are many survey data on the radioactive contamination of milk and milk products, but information about meat and eggs is very few in this respect. (Japan)

6083 DECORPORATION OF RADIONUCLIDES. Studies on Polonium. Volf, V. (Kernforschungszentrum, Karlsruhe, Ger.). Strahlentherapie; 145: No. 1, 101-115(1973). (In German).

In rats, the effect on ^{210}Po-distribution of various chelating agents was studied in relation to the ir dose and time of administration. In blood, spleen, and skeleton, the following SH-substances proved effective: 2,3-Dimercaptopropane-1-sulfonate > Diethyldithiocarbamate > 2-Mercaptopropionylglycine > D-Penicillamine. However, diethyldithiocarbamate increased the accumulation of ^{210}Po in liver, and brain, and the other thiols stimulated its deposition in the kidneys. Diethylenetriaminepentaacetate and two sulphur-containing polyaminopolycarbonic acids did not influence the distribution pattern of ^{210}Po. Theoretical and practical implications of the results are discussed. (GE)

6084 ELIMINATION OF INHALED PLUTONIUM OXIDE PARTICLES BY IN VIVO LUNG WASHOUT. Nolibe, D. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). Compt. Rend., Ser. D; 276: No. 4, 681-684(22 Jan 1973). (In French).

As lung washout processes are only about 10% efficient, it is necessary to repeat the process several times. It was observed that the efficiency of the process becomes constant between the 10th and 40th day after contamination of the lungs with a 70 to 200 μCi burden. During this delay period, repeated treatments can be carried out. On the other hand when higher doses are considered it is found that the efficiency of the treatment decreases rapidly. It is thus necessary to intervene within a shorter delay period. This last observation implies that the rate of lung washout treatments must be adapted to the dose inhaled. (France)

6085 LOCALIZATION IN HYPOTHALAMUS OF INCREASED INCORPORATION OF ^{3}H CYTIDINE INTO RNA IN RESPONSE TO ORAL HYPERTONIC SALINE. George, J. M. (Ohio State Univ., Columbus). Endocrinology; 92: No. 5, 1550-1555(May 1973).

Autoradiography was performed on serial sections of the hypothalamus of mice given oral hypertonic saline using incorporation of ^{3}H cytidine into RNA as an index of cellular activity. Of the 18 areas of the hypothalamus examined, increased activity in saline treated mice was found in 3 areas; supraoptic nucleus, medial portion of arcuate nucleus, and ependymal cells lining the third ventricle adjacent to arcuate nucleus. The increased activity of the supraoptic nucleus is consistent with its known function of increased vasopressin synthesis in response to dehydration. The significance of the findings in the arcuate nucleus remains to be determined but this area may be involved in the reception and transmission of the thirst stimulus or in a stress response. This method is presented as a non-invasive technique for localizing hypothalamic response to specific physiologic stimuli. (auth)

6086 RETENTION OF TRITIUM AND IODINE-125 LABEL IN LIVER DEOXYRIBONUCLEIC ACID OF THE NORMAL AND PARTIALLY HEPATECTOMIZED MOUSE AFTER INJECTION OF ^{3}H-THYMIDINE (^{3}H-5-METHYL) AND ^{125}I-5-iodo-2' DEOXYURIDINE. Douple, E. B. Lawrence, KS; Univ. of Kansas (1972). 118p. University Microfilms Order No. 73-11,877.

Thesis (Ph.D.).

In a group of five experiments, over 400 male albino mice were injected with 0.2 ml of different specific activities of tritium or ^{125}I label in the form of ^{3}HTdR or ^{125}IUdR. The total quantity of thymidine remained constant at 5×10^{-6} millimoles, but the injected solutions contained 1, 5, 20, or 100 microcuries of tritium label. Two quantities of iododeoxyuridine molecules were injected—either 5×10^{-6} millimoles or 5×10^{-8} millimoles. The activities of ^{125}I label administered via intraperitoneal injection were 1, 5, 25, and 50 microcuries. Over half of the animals were partially-hepatectomized 39.5 hr prior to receiving the injected radioisotopes. The animals were sacrificed by cervical dislocation at various time periods up to 7, and in some cases 10, weeks after injection. The animals were weighed, the livers were removed and weighed, and the liver DNA was extracted using a modified version of the Schmidt–Thannhauser technique. DNA samples were assayed radiometrically using liquid scintillation counting for tritium and NaI crystal well-counting for ^{125}I. The samples were assayed quantitatively using uv spectrophotometry. The retention of tritium and ^{125}I label was examined in liver DNA of the normal and partially-hepatectomized mice after injection of ^{3}HTdR and ^{125}IUdR. The experimental procedure permitted examination of body weights, liver weights, extracted DNA content and activity per gram of liver, and total ^{125}I activity per gram of liver as a function of time after injection. An attempt was made to characterize a previously demonstrated radiation effect in the liver of the mouse, the accelerated turnover of tritium label per gram of wet tissue following the injection of increasing specific activities of ^{3}HTdR. Experimental results indicate that a flooding of the DNA precursor pool may occur in the non-proliferative liver of the mouse following injection of as few a number as 5×10^{-6} millimoles of iododeoxyuridine. There is evidence that the DNA extracted using the modified biochemical fractionation procedure may decrease with time in the normal mouse. There is no evidence to support a contention that ^{125}I label in the DNA of the mouse is much more radiotoxic when compared to intranuclear tritium label. Several curves showing retention of radioactive labels in the extracted DNA were not biphasic and two distinguishable components of the DNA with different biological half-lives were not readily apparent. The results provided no evidence for significant reutilization of tritium label relative to ^{125}I label in normal mouse liver but some evidence is present for reutilization of tritium label in regenerating mouse liver. A radiation effect resulting from incorporation of different specific activities of ^{3}HTdR and ^{125}IUdR was not apparent in the body weights, liver weights, DNA content, or DNA specific activity of normal and partially-hepatectomized mice. However, it is possible that a radiation effect may have been obscured in the DNA specific activity and in the DNA activity per gram of liver as a result of a flooding of the DNA precursor pool, an excessive variation in the response to surgical treatment, or a limitation imposed by the component of extracted DNA. The radiation effect may appear at a time period later than 45 days. (Diss. Abstr. Int., B)

6087 EFFECT OF REPLACEMENT OF MEDIUM POTASSIUM BY SODIUM, CESIUM OR RUBIDIUM ON IN VITRO IODIDE TRANSPORT AND IODOAMINO ACID SYNTHESIS BY RAT THYROID. Haibacn, H.; Greer, M. A. (St. Louis Univ.). Proc. Soc. Exp. Biol. Med.; 143: No. 1, 114-117(May 1973).

Rat thyroid lobes were incubated in Krebs–Ringer-phosphate (KRP) solution containing ^{131}I. Their ability to concentrate and to organically bind ^{131}I was compared with thyroid lobes incubated in KRP in which the potassium was replaced by equimolar amounts of sodium, rubidium, or cesium. Both uptake and organic binding of ^{131}I were depressed by sodium substitution. ^{131}I uptake was near normal but organic binding of ^{131}I was markedly depressed with cesium substitution. Rubidium was as effective as potassium in maintaining both these functions. It is concluded that the cation concentration of the medium is important in the maintenance of both iodide transport and organic binding of that iodide which enters the thyroid gland. These two functions differ in their cation requirements since cesium restores the capacity to concentrate iodide to a much greater degree than it does the capacity for organic binding of iodine. (auth)

6088 RADIOAKTIVNYE VESHCHESTVA I KOZHA (METABOLIZM I DEZAKTIVATSIYA). (Radioactive Substances and the Skin (Metabolism and Deactivation)). Il'in, L. A. (ed.). Moscow; Atomizdat (1972). 304p.

This book is divided into two parts; the first is concerned with the metabolism of radioactive materials as a result of contact with the integument (skin). Their penetration, distribution in the skin and exchange with other elements, reaction with specific biological components, and general intake by the organism were examined for ^{89}Sr, ^{140}Ba, ^{141}Ce, ^{147}Nd, ^{99}Mo, and ^{132}Te. Mechanisms of contamination removal from the skin, efficiencies of various methods, and the effect of decontamination agents on the resorption of radioactive substances through the integument are discussed. (524 references.) (KSW)

6089 URANYL NITRATE INDUCED ACUTE RENAL FAILURE IN THE RAT: EFFECT OF VARYING DOSES AND SALINE LOADING. Ryan, R.; McNeil, J. S.; Flamenbaum, W.; Nagle, R. (Walter Reed Army Medical Center, Washington, DC). Proc. Soc. Exp. Biol. Med.; 143: No. 1, 289-296(May 1973).

Increasing doses of intravenous uranyl nitrate above 2.5 mg/kg of body weight result in more extensive renal tubular necrosis without increasing azotemia in the rat. Despite a uniform level of azotemia, renal tubular epithelial dysfunction tended to parallel the changes in renal tubular pathology. Saline loading, designed to suppress the renin–angiotensin system, ameliorated the azotemia but not the tubular necrosis or tubular dysfunction after uranyl nitrate. These results suggest that passive backflow of glomerular filtrate through necrotic tubular epithelium is not responsible for the azotemia after uranyl nitrate in the rat. The protection afforded by saline loading further suggests a role for the renin–angiotensin system in the development of uranyl nitrate induced acute renal failure. (auth)

6090 SPECIAL CAGE FOR A LONG-TERM KEEPING OF SMALL LABORATORY ANIMALS WITH INCORPORATED RADIONUCLIDES. Kofranek, U.; Taborik, J. (Inst. of Hygiene and Epidemiology, Prague). Zdrav. Tech. Vzduchotech.; 15: No. 2, 71-74(1972). (In Czech).

A special unit is described where small laboratory animals can permanently be kept that were administered radioactive substances with gaseous daughters. The unit meets the requirements for closed, ventilated cages where a large number of experimental animals can be kept while all safety regulations are observed relating to installations handling radioactive substances (the Czechoslovak standard CSN 34 1730). The unit does not require much room and is economical. (NSA of Czechoslovakia)

6091 EFFECT OF CHELATING AGENTS ON THE DISTRIBUTION OF ^{210}Po IN RATS. Volf, V. (Institut fuer Strahlenbiologie, Karlsruhe, Ger.). Experientia; 29: No. 3, 307-308(15 Mar 1973).

Adult rats were injected intravenously with ^{210}Po in 0.1 N HNO_3. The chelating agents, sodium 2,3-dimercaptopropane-1-sulfonate (DMPS), sodium diethyldithiocarbamate (DDC), D-penicillamine (PA), 2-mercaptopropionylglycine (MPG), and DTPA, were administered intraperitoneally or orally. After 48 h the animals were killed and the alpha activity of tissue samples was determined. The effectiveness of the chelating agents decreased in the order: DMPS > DDC > MPG > PA. DTPA showed hardly any effect. There was a marked diminution of ^{210}Po retention in the blood, spleen, and bone. (HLW)

Plants

Refer also to abstracts 5559 and 5560.

Microorganisms

6092 EVIDENCE FOR THE DIRECT ACTION OF COLICIN K ON AEROBIC $^{32}P_i$ UPTAKE IN ESCHERICHIA COLI IN VIVO AND IN VITRO. Takagaki, Y.; Kunugita, K.; Matsuhashi, M. (Tokyo Univ.). J. Bacteriol.; 113: No. 1, 42-50(Jan 1973).

Pentachlorophenol (PCP)-sensitive incorporation of ^{32}P-labeled orthophosphate ($^{32}P_i$) into nucleotides and nucleic acids by disrupted spheroplasts of Escherichia coli was inhibited by addition of colicin K. Incorporation by intact cells was also inhibited by a similar concentration of colicin K. Various colicin K-resistant mutants were isolated, and their ability to incorporate $^{32}P_i$ was tested. When T6^{r}-colK^{r} mutants (T6 phage-resistant) and tol I mutants (T6-sensitive, colicin E-sensitive) were converted to disrupted spheroplasts, their $^{32}P_i$-incorporation became sensitive to colicin K. On the contrary, incorporation by disrupted spheroplasts from tol II mutants (T6-sensitive, colicin E-resistant) was fairly resistant to colicin K like that of intact cells. A modification of the cell surface of T6^{r}-colK^{r} mutants, caused by mutation to novobiocin-permeable, T4 phage-resistant cells, restored the sensitivity of the cells to colicin K. The modified T6^{r}-colK^{r} cells did not adsorb T6 phage or colicin K, indicating that the receptors for T6 phage or colicin K are not reactivated by this modification. Similar treatment of tol I mutants did not have this effect. These observations strongly suggest that colicin K can act on its target on the cell membrane if it can penetrate the cell surface to reach this target. The receptor for colicin K on the cell surface, which may be part of the T6 phage-receptor, may have some unknown function in relation to the action of colicin K in normal cells, but tends to become dispensable if the cells become permeable to colicin K. (auth)

New Tracer Techniques

Refer also to abstracts 5423, 6002, and 6077.

6093 NEW RADIOISOTOPE TEST FOR DETECTION OF DEEP VENOUS THROMBOSIS IN THE LEGS. Duffy, G. J.; D'Auria, D.; Brien, T. G.; Ormond, D.; Mehigan, A. J. (Saint Luke's Hospital, Dublin). Brit. Med. J.; 1: No. 5855, 712-714 (24 Mar 1973).

A commercial preparation of ^{131}I-labeled macroaggregates of albumin (m.a.a.) was used in an attempt to diagnose and localize thrombi in the leg veins. The procedure was performed at the bedside and the result was available in 30 min. Thirty-one patients with clinical evidence suggestive of deep venous thrombosis in the legs were studied by the radioisotope method and by phlebography. There was agreement in 18 of 21 legs shown to contain thrombus on phlebography and in 9 of 10 legs shown to be free of thrombosis on phlebography. There was, however, lesser agreement on the site of thrombosis between the two methods. (auth)

6094 MICROBIAL PROTEIN SYNTHESIS IN THE RUMEN: ASSESSMENT OF RADIOACTIVE PHOSPHOROUS AS A MARKER FOR CELLULAR GROWTH. Bucholtz, H. F. East Lansing, MI;

Michigan State Univ. (1972). 130p. University Microfilms Order No. 73-5338.
Thesis (Ph. D.).

Seven experiments were conducted to determine the feasibility of using radioactive phosphorus (^{33}P) incorporation into microbial phospholipids (PL) as a marker of microbial growth (protein synthesis) in whole rumen contents. Results from experiments showed that N/PL–Pi (nitrogen to phospholipid–phosphorus) ratios were not similar for 12 strains of pure rumen bacteria, mixed rumen bacteria, or rumen protozoa. The N/PL–Pi ratio also differed in rumen bacteria collected from the same sheep at different times after feeding and incubated in vitro with different levels of substrate. These experiments showed that a N/PL–Pi ratio would need to be determined separately for bacteria and protozoa in each experiment designed to determine the rate of microbial cell (protein) synthesis. The metabolism of ^{33}P by rumen bacteria was studied in vitro. ^{33}P uptake and incorporation into the intracellular phosphorus (IC–Pi) and PL–Pi fractions were linear with time and paralleled changes in cell growth. Before substrate addition to the incubation medium, ^{33}P uptake was noted into the IC–Pi fraction but ^{33}P was not incorporated into the PL–Pi fraction. The specific activity (SA) of the IC–Pi pool was assumed to represent the phosphorous precursor pool for microbial PL synthesis. The rate of ^{33}P incorporation into microbial PL was studied during in vitro incubations of whole rumen contents obtained from sheep feed either a high (15.7%) or a low (6.1%) protein ration of similar digestible energy. Rate of ^{33}P incorporation into microbial PL in the rumen contents collected from the sheep fed the high protein ration was highest for the 2 and 4 hour (before) after feeding incubations. These rates of ^{33}P incorporation into microbial PL are indicative of microbial cell growth rates that occur in vivo when low or high nitrogen diets are fed to ruminants. Results of experiments showed that ^{33}P incorporation into microbial PL can be used to determine microbial cell growth in systems using whole rumen contents. The rate of rumen microbial cell (protein) synthesis was measured using 60-minute in vitro incubations of whole rumen contents collected from a sheep at 0, 2, 4, 9, and 11 hours after the a.m. feeding. (Diss. Abstr. Int., B)

6095 ORBITAL SCINTIGRAPHY USING TECHNETIUM-99M LABELED FERROUS ASCORBATE. Utilization of the Method in the Diagnosis of Lesions in the Orbital Space. Mamo, L.; Clay, C. (Hopital Lariboisiere, Paris). Nouv. Presse Med.; 1: No. 46, 3107-3110(23 Dec 1972). (In French).

Orbital scintigraphy using technetium-99m-labeled ferrous ascorbate appears to be a useful method for diagnosing lesions. The method enabled the existence of orbital tumors to be confirmed or refuted in the case of 51 patients examined by scanning exploration techniques and an etiologic diagnosis to be made in 90% of the cases. (France)

6096 CLINICAL USE OF ^{99m}Tc–DIPHOSPHONATE (HEDSPA). A New Agent for Skeletal Imaging. Pendergrass, H. P.; Potsaid, M. S.; Castronovo, F. P. (Harvard Medical School, Boston). Radiology; 107: No. 3, 557-562(Jun 1973).

Clinical experience in over 500 patients scanned with ^{99m}Tc–diphosphonate is discussed. In comparison with ^{18}F scans and roentgen studies, ^{99m}Tc–diphosphonate has produced similar or better studies. Frequently, the diphosphonate scan is more sensitive, especially in the detection of metastases to bone. In addition, calcific soft-tissue deposits and urinary tract pathology have been visualized on ^{99m}Tc–diphosphonate scans. Scanning with ^{99m}Tc–diphosphonate is considered to be the most effective imaging modality available for determining the presence and extent of skeletal metastases. (auth)

6097 EFFECT OF CHANGES IN ANTRAL pH ON THE BASAL RELEASE OF GASTRIN. Becker, H. D.; Reeder, D. D.; Thompson, J. C. (Univ. of Texas, Galveston). Proc. Soc. Exp. Biol. Med.; 143: No. 1, 238-240(May 1973).

Gastrin concentrations in the blood draining the gastric antrum were measured by radioimmunoassay during changes in the antral pH. Neutralization of the antrum (raising the basal ambient pH of 3.5 to 5 to 7 or 8) resulted in a significant increase of antral venous gastrin concentration. Acidification of the antrum significantly lowered, but did not abolish, the basal release of gastrin. These studies demonstrated, by direct measurement of gastrin, the presence of a very sensitive feedback mechanism between antral pH and gastrin release, and that gastrin may be released by simply raising the basal antral pH to 7. (auth)

6098 RADIOIMMUNOASSAY AND COMPETITIVE PROTEIN BINDING ASSAY OF C-REACTIVE PROTEIN. Burns, R. G. Lo Angeles; Univ. of California (1972). 180p. University Microfilms Order No. 73-6378.
Thesis (Ph. D.).

C-reactive protein (CRP) is an acute phase component of blood appearing in response to various stresses. Previous detection techniques have been limited in response time and sensitivity. Consequently, clinical use of CRP levels to follow the course of diseases had been limited as has the ability to elucidate biochemical and physiological parameters of the protein. Two measurement techniques were developed to detect CRP. Both made use of the principle of competitive inhibition of CRP in samples with radiolabeled CRP for binding to receptor molecules. This competition was quantified in the form of dose response curves by using CRP standards and measuring inhibition. From the dose response curves, unknown concentrations of CRP in samples were detected by the amount of inhibition they produced. The first technique utilized a competitive protein binding assay with phosphorylated cellulose as the binding agent. This assay could give results in a few hours and was sufficiently sensitive to quantify CRP in concentrations commonly found in patients with various diseases. This permitted assessment of changing values during the course of a disease, and assessment of the effects of treatment. The second technique was a radioimmunoassay with a specific antiserum to CRP as the binding agent. This assay had a sensitivity one thousand times greater than other methods reported. Using this assay it was possible to measure and evaluate very small CRP concentrations present in the serum of apparently healthy individuals, not heretofore detectable. To develop both assays, careful attention was given to the isolation and characterization of assay components from biological materials. Specificity and affinity of binding CRP to phosphorylated cellulose and antiserum were investigated and quantified. The interaction of substances such as CRP subunits and erythrocyte catalase with CRP binding was determined. (Diss. Abstr. Int., B)

6099 DEVELOPMENT OF A QUANTITATIVE IMMUNOLOGICAL ASSAY FOR THE STUDY OF SPORE COAT SYNTHESIS AND MORPHOGENESIS. Horn, D.; Aronson, A. I.; Golub, E. S. (Purdue Univ., Lafayette, IN). J. Bacteriol.; 113: No. 1, 313-321(Jan 1973).

A quantitative assay employing ^{125}I-labeled antibody was developed for Bacillus cereus T spore coat protein. Populations of antibody molecules with various affinities for inner or outer coat can be prepared by selective adsorption to and elution from different coat preparations. Adsorption to and elution from intact spores result in an antibody preparation at least 15 times more reactive to outer coat. This antibody is useful for measuring the time and extent of spore coat maturation, i.e., outer spore coat formation. Rifampin inhibits the increase in content of this coat antigen. (auth)

6100 AVIAN ONCORNAVIRUS GROUP-SPECIFIC ANTIGEN: DETECTION AND QUANTIFICATION BY RADIOIMMUNOASSAY. Fritz, R. B.; Qualtiere, L. F. (Emory Univ., Atlanta). J. Virol.; 11: No. 5, 736-740(May 1973).

A double-antibody competitive-inhibition radioimmunoassay for avian group-specific antigen is described. A viral protein preparation, consisting primarily of gs-1, was labeled with radioiodine. Hamster and rabbit antisera were reacted with the labeled antigen, and the resultant antibody-antigen complexes were precipitated with the appropriate antiglobulin. Standard curves based on the inhibition of binding of labeled antigen to antibody after preincubation with unlabeled antigen were prepared. These showed the lower limit of sensitivity to be 2 to 10 ng of unlabeled protein when labeled antigen of 2,000 to 5,000 counts per min per ng of specific activity was used in the assay. Extracts of avian oncornavirus-infected cells, likewise, were able to inhibit binding of labeled antigen. This technique will be very useful for the quantification of small amounts of oncornavirus group-specific protein. (auth)

6101 RADIOIMMUNOPRECIPITATION TEST FOR DETECTION OF MYCOPLASMA PNEUMONIAE ANTIBODY. Brunner, H.; Chanock, R. M. (National Institutes of Health, Bethesda, MD). Proc. Soc. Exp. Biol. Med.; 143: No. 1, 97-105(May 1973).

A radioimmunoprecipitation (RIP) test for detection of antibody to M. pneumoniae was developed. The test was performed by using microtiter equipment thus combining ease of performance and the need for small amounts of reagents. Divalent cations did not enhance the RIP antibody titer of human sera to M. pneumoniae indicating that complement or complement components were not fixed. Membrane glycolipids appeared to be the major although not the only antigens involved in the RIP reaction. The RIP method was slightly more sensitive than the complement dependent mycoplasmacidal antibody assay and considerably more sensitive than the standard serologic techniques used for measurement of antibody to M. pneumoniae. (auth)

6102 ^{51}Cr MICROASSAY TECHNIQUE FOR CELL-MEDIATED IMMUNITY TO VIRUSES. Steele, R. W.; Hensen, S. A.; Vincent, M. M.; Fuccillo, D. A.; Bellanti, J. A. (Georgetown Univ., Washington, DC). J. Immunol.; 110: No. 6, 1502-1510(Jun 1973).

A ^{51}Cr microassay procedure for the in vitro measurement of cell-mediated immunity to rubella virus is described. The technique consists of a lymphocyte target cell interaction employing tissue culture lines chronically infected with rubella virus in which the quantitative release of ^{51}Cr is used as an index of lymphocyte reactivity. Also described in these studies is an apparatus that separates the reacting cells from supernatant fluids and recovers the released ^{51}Cr. Significant release is only observed with lymphocytes from rubella seropositive individuals and the reaction is inhibited by rubella hyperimmune sera. The microassay technique also appears to be applicable for the study of cellular immunity to a wide variety of viral agents. (auth)

6103 CAVAL-PORTAL SHUNTING AS A CAUSE OF A FOCAL INCREASE IN RADIOCOLLOID UPTAKE IN NORMAL LIVERS. Holmquest, D. L.; Burdine, J. A. (Baylor Univ., Houston, TX). J. Nucl. Med.; 14: No. 6, 348-351(Jun 1973).

Discrete focal regions of increased radiocolloid uptake on the anterior surface of the midportion of the liver were studied in two patients presenting with superior vena caval obstruction secondary to a metastatic fibrosarcoma and a primary oat cell carcinoma of the lung. It was shown that these concentrations of activity result from an unusual collateral circulation from the superior vena cava to anterior branches of the portal venous circulation, most likely by way of blood flow through the umbilical vein. The demonstrated fact that a focal area of increased radiocolloid uptake can be the consequence of superior vena caval obstruction has a major implication for the nuclear medicine physician. Because the majority of superior vena caval obstructions result from neoplastic disease, and because the liver scan is commonly used as a screening procedure for detecting metastatic spread of a tumor, it is important that these focal concentrations not be misinterpreted as absolute evidence of neoplastic disease in the liver. (auth)

6104 DEUTSCHER ROENTGENKONGRESS. 53. Tagung d. Deutschen Roentgen-Gesellschaft, Gesellschaft fuer Medizinische Radiologie, Strahlen-Biologie und Nuklear-Medizin e.V. Stuttgart, 10.–13.5.72. (German Roentgen Congress. 53rd Meeting of the German Roentgen Society, Society for Medical Radiology, Radiation Biology, and Nuclear Medicine. Conference Held at Stuttgart May 10–13, 1972). Frankfurt am Main; Behringwerke AG (1972). 397p. (CONF-720585-(Absts.)).

. From 53rd German Roentgen Congress Conference; Stuttgart, F.R. Germany (10 May 1972).

Abstracts of 350 papers on diagnostic uses of radiations and radioisotopes presented at this Congress are included in the German language. New techniques in diagnostic roentgenography and nuclear medicine are described, and results of radiobiological studies of medical significance are reported. (CH)

6105 DETERMINATION OF IRON ABSORPTION FROM MEASUREMENTS OF RADIOACTIVE IRON AND A NON-ABSORBED RADIOACTIVE MARKER IN A SINGLE FAECAL SAMPLE. Jasani, B. M. (Medical Research Council, London); Fletcher, J. Scand. J. Haematol.; 9: 547-551(1972).

Iron absorption has been estimated from the ratio of radioactive iron and a nonabsorbed radioactive marker appearing in a single specimen of faeces after the radionuclides had been administered together with a standard meal. In a number of patients with widely differing iron absorptions the results agreed with values of iron absorption measured by whole-body counting. This means that it is possible to measure iron absorption by a single stool collection made within 1 or 2 days of giving the radionuclides. (auth)

6106 EVIDENCE FOR DNA REPAIR REPLICATION IN UNIRRADIATED MAMMALIAN CELLS: IS IT AN ARTIFACT? Gautschi, J. R.; Young, B. R.; Painter, R. B. (Univ. of California, San Francisco). Biochim. Biophys. Acta; 281: 324-328(27 Oct 1972).

Unirradiated HeLa, CHO, and L cells were incubated with [^{3}H]bromodeoxyuridine according to procedures used to measure repair replication after ultraviolet or x irradiation. In contrast to earlier reports, no incorporation of [^{3}H]bromodeoxyuridine into extant normal density DNA can be found when single-stranded DNA is prepared under alkaline conditions. Thus, there is no evidence that repair replication occurs in unirradiated cells, and previous reports can be ascribed to artifacts. (auth)

6107 DETERMINATION OF THE CARDIAC OUTPUT WITH RADIOISOTOPES. Lopez-Majano, V. (Veterans Administration Hospital, Hines, IL); Kaplan, F.; Rhodes, B. A. (Veterans Administration Hospital, Hines, IL). Cor Vasa; 13: No. 2, 124-135 (1971).

The regional distribution of the cardiac output was studied by introducing radioactive particles larger than the size of the capillaries in the left side of the heart. These particles were albumin macro-aggregates and/or albumin microspheres, labelled with a radioisotope suitable for external detection, such as ^{99m}Tc or ^{131}I. These particles can be used clinically. Other types of particles, such as carbonized plastic microspheres labelled with ^{169}Yb, are not metabolizable, and can be used for experimental work only. The detection of radioactivity was carried out by a rectilinear scanner or a gamma camera. Another method consists in the injection of a bolus of ^{99m}Tc and its detection by a gamma camera. The cardiac output was calculated using the ratio of injected counts (counts in the syringe before injection–counts left in the syringe) to counts in the selected area multiplied by the time needed to reach equilibrium in the number of counts. (Nucl. Sci. Abstr. Czech.)

MATERIALS

6108 (AD-755429) BIBLIOGRAPHY ON SHOCK WAVES IN SOLIDS. Lehto, D. L. (Naval Ordnance Lab., White Oak, Md.). 17 Nov 1972. 149p. (NOLTR-72-274). NTIS.

About 850 references are given to books, articles, and reports on theoretical and experimental aspects of shocks in solids. The topics include computer codes, composite media, and equations of state. (auth) (NTIS)

6109 (BNL-50336) INTERACTION OF ENERGETIC CHARGED PARTICLES WITH SOLIDS. A Summer School in Memory of Cavid Erginsoy Held at Robert College, Istanbul, Turkey, August 16-28, 1971. Goland, A. N. (ed.) (Brookhaven National Lab., Upton, N. Y.). Feb 1973. Contract AT(30-1)-16. 414p. Dep. NTIS $3.00.

The thirteen technical papers included cover various topics between solid-state and nuclear physics. Separate abstracts were prepared for ten of them; the remaining three were on plasmons in solids, thermodynamics of simple defects, and positron annihilation in defect studies in metals. (DLC)

For abstracts of individual papers see: 5605, 5606, 6363–6365, 6379, 6697, 6698, 7188, and 7189.

6110 THEORETICAL SOLID STATE PHYSICS. Volume 1. Haug, A. International Series of Monographys in Natural Philosophy, Volume 36. Elmsford, NY; Pergamon Press, Inc. (1972). 510p. $21.00.

Translation of Theoretische Feskoerperphysik, Band I by H. S. H. Massey.

Chapter I elucidates the basic concepts and structures of solid-state physics. Chapter II discusses the phenomena which are essentially electronic in nature (single-electron approximation, many-electron problem, crystal binding, magnetic properties, dielectric properties). Chapter III discusses the properties of the crystal lattice, including thermal conductivity and specific heats. (DLC)

6111 THEORETICAL SOLID STATE PHYSICS. Volume 2. Haug, A. International Series of Monographys in Natural Philosophy, Volume 46. Elmsford, NY; Pergamon Press, Inc. (1972). 367p. $18.00.

Translation of Theoretische Feskoerperphysik, Band II by H. S. H. Massey.

The three chapters discuss the electron–lattice interaction, conductivity phenomena, effects of lattice defects (semiconductors, luminescence), and general problems of this interaction, such as superconductivity and polarons. (DLC)

Ceramics and Cermets

Refer also to abstracts 5186, 5363, 5386, 5387, 5858, 5859, 6235, 6236, 6316, 6317, 6332, 6333, 6363, 6366, 6383, 6709, 7189, 7286, 7295, 7330, 7342, 7371, and 7379.

6112 (AD-753124) ALLOYING AND THERMAL TREATMENT OF CERAMICS. Final Report, 1 June 1968–30 September 1972. Fine, M. E.; Cohen, J. B.; Johnson, D. L. (Northwestern Univ., Evanston, Ill. Dept. of Materials Science). 30 Nov 1972. 16p. (AFOSR-TR-72-2108). NTIS.

The object of the research was to provide basic information which would be useful for the technology of alloying and thermal treatment of ceramics. Specifically, magnesioferrite precipitates gave substantial strengthening to magnesium oxide. Magnetite precipitates in wustite, iron in iron oxide, and zirconium in zirconia increased both fracture initiation energy and fracture strength. Spinodal decomposition was found in cobalt ferrite-cobalt oxide system. Material with very high coercive force resulted. (GRA)

6113 (ANL–7977) CHEMICAL ENGINEERING DIVISION FUELS AND MATERIALS CHEMISTRY SEMIANNUAL REPORT, JULY–DECEMBER 1972. Chasanov, M. G.; Johnson, C. E.; Blackburn, P. E.; Johnson, I.; Martin, A. E.; Tetenbaum, M.; Harkness, A. L.; Crouthamel, C. E.; Levenson, M.; Vogel, R. C. (Argonne National Lab., Ill.). Apr 1973. Contract W-31-109-eng-38. 43p. AT $4.00.

To aid in evaluating the performance of fast-breeder reactor fuels, high-temperature studies are being made of the U–Pu–O–Na and U–Nd–O systems and modeling studies of oxygen potentials over oxide fuels are being performed. Kinetic studies of the reaction of sodium with sintered mixed-oxide pellets are reported. Oxygen potentials over the U–Nd–O system are reported. Modeling studies for oxygen activities over irradiated fuels are presented. The previously reported theory for oxygen potentials over $UO_{2\pm x}$ is extended to urania-plutonia systems and the agreement between theory and experiment is presented. In the study of the chemical behavior of irradiated fast-reactor fuels, two approaches are being taken. Laboratory experiments are being performed to simulate the type of corrosive attack of fuel cladding observed in irradiated fuels. Irradiated mixed-oxide fuel specimens are being examined by electron probe microanalysis and ion microprobe mass analysis. Both types of experiments provide insight into the chemical interactions occurring in nuclear fuels during irradiation. (auth)

6114 (CONF-730402–(P1-2), pp 158-164) PHASE EQUILIBRIA IN THE YTTERBIUM–CARBON–HYDROGEN SYSTEM. Haschke, J. M. (Univ. of Michigan, Ann Arbor). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Phase equilibria in the ytterbium–carbon–hydrogen system were investigated for various C/Yb ratios along sections of constant hydrogen fugacity. Chemical and crystallographic data showed the existence of a hexagonal phase near the $YbC_{0.5}H_y$ composition and a fcc phase near the $YbC_{1.0}H_z$ composition. Crystallographic data are presented, and the results of hydrolysis and vaporization experiments are described. The effects of oxygen contamination in both the Eu–C and Yb–C–H systems are discussed. (17 references) (auth)

6115 (CONF-730402–(P1-2), pp 176-183) OXIDATION STATES IN THE SYSTEM PrO_x–CeO_2 AT VARIOUS OXYGEN PRESSURES. Brauer, G.; Willaredt, B. (Univ., Freiburg i. B.). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Mixtures of praseodymia and ceria were prepared over the whole composition range by coprecipitation and then were treated under 0.2, 1.0, and 10 atm oxygen. Lattice parameter variations show that pure praseodymia is present as β–$PrO_{1.83}$ at 0.2 and 1 atm, and as $PrO_{2.0}$ at 10 atm which form a continuous series of solid solutions with CeO_2. A two-phase region of β phase and α phase ($PrO_{2.0}$–CeO_2) extends from 10 to 20 mole % ceria at 0.2 atm and from 2 to 10 mole % ceria at 1 atm. A diagram is given of the oxidation state of Pr in PrO_x–CeO_2 mixtures. (DLC)

6116 (CONF-730402–(P1-2), pp 184-193) OXYGEN TRANSPORT IN $Pr_7O_{12} \pm \delta$ SINGLE CRYSTALS. Lau, K. H.; Eyring, L. (Arizona State Univ., Tempe). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

PrO_2 single crystals were reduced to Pr_6O_{11} and then to Pr_7O_{12}; isotope exchange with ^{18}O was carried out. The temperature dependence of the diffusion coefficient was studied at three different pressures (72.12, 106.19, and 200.49 torr) over the temperature range 745 to 900°C. The diffusion coefficient obeys the equations $D = 7.337 \times 10^{-7} \exp(-15.997\ \mathrm{kcal}/RT)$ at 72.12 torr, $6.275 \times 10^{-7} \exp(-14.974\ \mathrm{kcal}/RT)$ at 106.19 torr, and $9.647 \times 10^{-7} \exp(-15.330\ \mathrm{kcal}/RT)\ \mathrm{cm}^2/\mathrm{s}$ at 200.49 torr. Results are discussed relative to a point defect model. (2 tables, 2 figures, 11 references) (DLC)

6117 (CONF-730402–(P1-2), pp 485-489) NEUTRON-DIFFRACTION STUDY OF $LaNi_5D_7$. Bowman, A. L.; Anderson, J. L.; Nereson, N. G. (Los Alamos Scientific Lab., NM). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

The neutron-diffraction pattern of $LaNi_5D_7$ can be indexed on a hexagonal unit cell, with $a_0 = 5.387(1)$ and $c_0 = 4.273(1)$, indicating that the hydridation resulted in a volume expansion of 24% in $LaNi_5$. The $LaNi_5$ lattice is slightly distorted, with a partially ordered filling of the possible hydrogen sites. (DLC)

6118 (CONF-730402–(P1-2), pp 520-526) POLYMORPHISM IN RARE-EARTH MOLYBDATES AND TUNGSTATES OF THE TYPES $R_2(MO_4)_3$ AND R_2MO_6. Sleight, A. W.; Brixner, L. H. (E. I. du Pont de Nemours and Co., Wilmington, DE). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Polymorphism of the title compounds was studied as a function of temperature and pressure. Five basic structure types are clearly established for the $R_2(MO_4)_3$ compounds, and all contain discrete MO_4 tetrahedra. Transitions between these structure types are diffusion controlled. Two of the five main structure types can distort; thus, inclusion of these distorted structures leads to a total of seven different modifications. These distortions involve displacive transitions which are always ferroelastic and sometimes ferroelectric. A given $R_2(MO_4)_3$ compound can exist in as many as four different modifications. Three structure types are found for rare-earth molybdates and tungstates of the type R_2MO_6. The M cation is tetrahedrally coordinated in one type, but the other two structure types apparently contain octahedrally coordinated M cations. Only diffusion controlled transitions have been observed for these R_2MO_6 compounds. (21 references) (auth)

6119 (CONF-730402–(P1-2), pp 546-553) ELECTRON-OPTICAL STUDY OF THE CRYSTAL CHEMISTRY OF THE TERBIUM–OXYGEN SYSTEM. Kunzmann, P.; Eyring, L. (Arizona State Univ., Tempe). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

A hydrothermal technique was used to prepare a Tb–O sample consisting of a mixture of delta phase, dioxide, and a new phase. Electron-diffraction patterns were used to study the structure. If the delta phase is heated sufficiently by the electron beam, reduction occurs, yielding first the iota phase and then the C-type sesquioxide. The new phase has a unit cell closely related to that of the beta phase ($M_{12}O_{22}$) which has been found stable in the Pr–O system; the a and c axes are the same as for beta but the b axis is doubled. (DLC)

6120 (CONF-730402–(P1-2), pp 554-562) SOLUBILITY OF RH_2 IN R BETWEEN AMBIENT AND 850°C (R = Gd, Er, Tm, AND Lu). Beaudry, B. J.; Spedding, F. H. (Ames Lab., IA). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

The lattice parametric method was used to establish the room temperature solubility; the solubility above 250°C was determined by an equilibration–analytical technique. A plot of solubility vs temperature showed a change in solvus slope at ~H/R = 0.30; at 850°C, all the solubilities were nearly the same. (DLC)

6121 (CONF-730402–(P1-2), pp 563-70) REDUCTION UNDER VACUUM OF Yb_2O_3 WITH GRAPHITE AT HIGH TEMPERATURE. de Pous, O.; Albert, L.; Fromaget, M.; Achard, J. C. (CNRS, Meudon-Bellevue, France). 1973. (In French).

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

The reduction under vacuum of ytterbium sesquioxide with graphite at high temperature gives, by condensing the sublimate, cubic ytterbium oxycarbide Yb_2OC with a parameter a = 4.868 Å. This formation can be explained by the direct reaction between ytterbium metal and carbon monoxide coming from the reduction. The same compound can be prepared by sublimation of the metal in carbon monoxide atmosphere. The magnetic moment from the study of thermal variation of reciprocal susceptibility was found in the vicinity of the theoretical value for Yb^{3+} ions. But oxycarbide, isoelectronic with YbN, cannot be taken as a completely ionic compound. (auth)

6122 (CONF-730402–(P1-2), pp 813-818) CONVERSION OF Y_2O_3 : Eu INTO Y_2O_2S : Eu AT THE SAME COLOR AND BRIGHTNESS. Forest, H. (Zenith Radio Corp., Melrose Park, IL); Ozawa, L. 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

The problem of converting Y_2O_3 : Eu phosphors into Y_2O_2S : Eu phosphors with no change in optical properties, during the manufacture of color TV tubes with recovery of the unused phosphor, is described. An empirical method was used which involved using different amounts of Y_2O_3 additions until the proper color was obtained. This necessitates a fast method for determining the proper color; the method selected was the measurement of the emission spectrum and the line intensity ratios of certain $^5D_1$ and $^5D_0$ emissions. This method was found to be reproducible and to result in accurate formulations. (DLC)

6123 (CONF-730402–(P1-2), pp 861-870) LANTHANIDE AND ACTINIDE MIXED-OXIDE SYSTEMS. Keller, C. (Inst. for Radiochemistry, Karlsruhe, Ger.). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Lanthanide and actinide oxides, with their fluorite lattice, are capable of taking into solid solution a wide variety of oxides, nitrides, and fluorides to form nonstoichiometric oxide phases. Discussions are presented of: (1) fluorite phases with mono- and divalent metal ions (including UO_2-PuO_2), (2) fluorite phases with trivalent elements ($ThO_2-RE_2O_3$, $UO_{2+x}-M_2O_3$, etc.), (3) fluorite phases with tetravalent elements, (4) fluorite phases with pentavalent elements, (5) oxide phases with bcc lattices, (6) oxide phases of the bronze type, and (7) oxide phases with actinides in the highest oxide states (neptunate, plutonate). (8 figures, 18 references) (DLC)

6124 (CONF-730402–(P1-2), pp 977-988) NEW METHOD FOR MONOCLINIC B-FORM PREPARATION OF YTTRIC RARE EARTH SESQUIOXYDES. Coutures, J. P.; Renard, R. (CNRS, Odeillo, France). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

The phases A (hexagonal), B(monoclinic), and C(cubic) of RE_2O_3 are discussed, and a phase stability diagram is given. An investigation was conducted of the use of vapor quenching to obtain the B(monoclinic) phase of RE_2O_3 (RE = Gd to Lu, Y). Unit cell parameters were calculated for each of the monoclinic oxides for two vaporization atmospheres (H_2 and N_2) and found to be in good agreement with these of Hoekstra. Vaporization weight loss and nonstoichiometry were also studied. (12 references) (DLC)

6125 (CONF-730402–(P1-2), pp 989-996) CRYSTAL CHEMISTRY AND MAGNETIC PROPERTIES OF Eu^{2+} TERNARY OXIDES. McCarthy, G. J.; Johnston, R. G.; Houlihan, J. F. (Pennsylvania State Univ., University Park). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

A research program is being conducted on Eu^{2+} ternary oxides. Synthesis techniques and crystal chemistry are reviewed. Bulk magnetic properties of these oxides which show magnetic ordering at low temperatures are tabulated (Eu aluminates, silicates, titanates, and tungstate), and measurements just completed on $EuWO_4$ are presented in graphs. (16 references) (DLC)

6126 (CONF-730402–(P1-2), pp 997-1006) THERMOGRAVIMETRIC STUDIES OF $La_2O_3-Cr_2O_3-O_2$ SYSTEM: LANTHANUM OXYCHROMATE. Berjoan, R.; Coutures, J. P. (CNRS, Odeillo, France). 1973. (In French).

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Thermogravimetry and diffractometry of the powder made it possible to demonstrate the formation of La_2CrO_6, starting with mixtures of La_2O_3 and Cr_2O_3 in an oxidizing atmosphere. Two new compounds appeared during the thermal dissociation of La_2CrO_6. These compounds contain that chromate ion, CrO_4^{2-}, that can be revealed by diffuse reflection spectrophotometry. Although chromium is also found in oxidation states below 6, these compounds seem to be mixed oxychromates of lanthanum. This study also shows that the thermal decomposition of La_2CrO_6 is a function of the oxygen pressure. (tr-auth)

6127 (CONF-730402–(P1-2), pp 1126-1134) APPLICATION OF THE SUPERPOSITION MODEL TO SOME OXYGENATED LATTICES DOPED WITH Eu^{3+}. Gaume, F.; Linares, C.; Blanchard, M. (Univ., Lyon). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

An interpretation is given of the crystal field parameters obtained from the optical data for $LaAlO_3$, La_2O_3, and La_2O_2S doped with Eu^{3+}. The superposition approximation described by Newman is used. (auth)

6128 (CONF-730524-1) SOL–GEL PROCESSES AT OAK RIDGE NATIONAL LABORATORY: DEVELOPMENT: DEMONSTRATION, AND IRRADIATION TESTS. Wymer, R. G. (Oak Ridge National Lab., Tenn.). 1973. 60p. Dep. NTIS $5.00.

From panel on Sol–Gel processes for fuel fabrication; Vienna, Austria (21 May 1973).

Developments in the sol–gel processes for preparation of single and combined actinide oxide sols are reviewed. Information and data are included in sections on process demonstrations including flowsheets, sol dispersion techniques, plutonia sol–gel process, basic studies, and radiation testing. (JRD)

6129 (CONF-730616-1) ADSORPTION ON ZIRCONIUM OXIDE. Holmes, H. F.; Fuller, E. L. Jr.; Beh, R. A. (Oak Ridge National Lab., Tenn.). 1972. 18p. Dep. NTIS $3.00.

From 47th National Colloid symposium; Ottawa, Ontario, Canada (18 Jun 1973).

The adsorptive characteristics of zirconium oxide were investigated by studying the adsorption of nitrogen, argon, and water. Surface properties were found to depend primarily on the amount of irreversibly adsorbed water retained by the sample. Water was found to irreversibly adsorb on zirconium oxide in amounts far in excess of that required for a classical chemisorbed monolayer. Weight loss for the sample between 25 and 500°C, in vacuum, was equivalent to 2.3 monolayers of chemisorbed water. Replacement of this water by adsorption from the vapor phase at 25°C became prohibitively slow after the irreversible adsorption of about 1.5 monolayers of water. In contrast to this, it was relatively easy to obtain reversible water vapor isotherms at 300 and 400°C. All three adsorbates showed that this sample of zirconium oxide has a pore system spanning the micro to macro size range. Irreversible adsorption of water causes a 20% decrease in the specific surface area as measured by nitrogen and argon. This reduction is real and occurs through the filling of micropores by irreversibly adsorbed water. Specific surface areas calculated from the water data suffer from the specificity of the interaction of water with the oxide surface and do not provide a true measure of the geometric area. (auth)

6130 (DP-Report–679) PREIRRADIATION TESTING OF HTR FUELS. Dragon Project. Holliday, J.; Hammond, S. E.; Hedderly, J.; Frampton, P. D.; Goergenyi, T.; Boerner, G. (Atomic Energy Establishment, Winfrith (England)). Oct 1969. 51p. (CONF-691140–3). Dep. NTIS (U. S. Sales Only) $4.75.

From fuel symposium; Bournemouth, UK (4 Nov 1969).

Reasons for testing and testing methods applicable to research and development fuels as well as quantity production fuels are discussed. Future developments in testing techniques with examples and with particular reference to automation and the use of statistics is also described. These testing methods are already in use, or are proposed in future developments at both Dragon and NUKEM fuel testing laboratories and refer to prismatic and spherical fuel bodies. (auth)

6131 (DP-Report–686) IRRADIATION BEHAVIOUR OF COATED-PARTICLE FUEL COMPACTS. Dragon Project. Everett, M. R.; Manzel, R.; Barr, P.; Mayr, K. (Atomic Energy Establishment, Winfrith (England)). Oct 1969. 23p. (CONF-691140–1). Dep. NTIS (U. S. Sales Only) $3.25.

From fuel symposium; Bournemouth, UK (4 Nov 1969).

Pre-irradiation and post-irradiation data on coated particle fuel compacts are summarized. The coatings used include high density pyrocarbon and SiC. The matrix incorporates actinide carbides in graphite. (JRD)

6132 (EUR–4772) FLUIDIZED-BED COATING OF NUCLEAR FUEL PARTICLES TOWARDS INDUSTRIAL SCALE OPERATIONS. Proceedings of the First Colloquium, Ispra, Italy, April 29, 1971. Flamm, J.; Van Velzen, D. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). May 1972. 62p. (CONF-710465–). Dep. NTIS (U. S. Sales Only). EUR B. Fr. 85.-.

Papers and discussions are included on fluidized bed coating of fuel particles, coating process costs, models for coating process research, models for coating process scale up, and aspects of industrial scale coating processes. (JRD)

6133 (IS–3054) FABRICATION OF ALUMINUM-SHEATHED ENRICHED UO_2–ALUMINUM MIXED-POWDER NUCLEAR FUEL ELEMENTS BY COEXTRUSION. Owen, C. V.; Scott, T. E.; McCorkle, W. H. (Ames Lab., Iowa). Jan 1973. Contract W-7405-eng-82. 22p. Dep. NTIS $3.25.

Three sizes of composite coextruded tubing containing 93%-enriched UO_2 and powdered aluminum have been produced. These are intended to provide desired characteristics for neutron converters (or high flux fast neutron facilities) in thermal neutron research reactors. Techniques developed for fabricating the three sizes of coextruded tubing are described. Suggestions are given for improving present fabrication procedures. (auth)

6134 (JPRS-59118) TRANSLATIONS ON METALLURGY. Translated from Porosh. Met., Akad. Nauk Ukr. SSR; No. 3, vp(1973). 18p. NTIS $3.50.

Four articles are presented on thermodynamic properties of refractory carbides in 0 to 3000°K temperature range, compatibility of silicon carbide fibers with tungsten substrate and titanium matrix, the stability of metal-base composite materials, and the thermal stability of titanium hydridonitrides. (auth)

6135 (JUL-921-RG) INVESTIGATIONS ON THE RELEASE BEHAVIOR OF ^{6}LI FROM NEUTRON-IRRADIATED SINTERED BeO COMPACTS ESPECIALLY BY USING SAMPLES OF DIFFERENT SIZE AND MATERIAL PROPERTIES. Neef, N. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Feb 1973. 100p. (In German). Dep. NTIS (U.S. Sales Only) $7.00.

Results of post-irradiation investigations on neutron-irradiated high-sintered BeO compacts are reported. The release behavior of ^{6}Li at different temperatures is studied. Samples of several producers with correspondingly different density and open porosity and different size are used. The detection of the ^{6}Li is made in a nondestructive test by neutron activation. The results are discussed and described quantitatively by the application of a modified diffusion theory. They are compared with other test results on low-sintered compacts. The examination of the size dependence of the release behavior allows the extension of the results to BeO spheres, which are likely to be used in a high-temperature breeder reactor. For these spheres the content of ^{6}Li during their in-core residence and the release during an out-of-pile thermal treatment are calculated. (auth)

6136 (LA–5136) $MC \cdot M'O_2$ COMPOSITES: A NEW THERMAL INSULATOR. Riley, R. E.; Taub, J. M. (Los Alamos Scientific Lab., N. Mex.). Feb 1973. Contract W-7405-eng-36. 18p. Dep. NTIS $3.00.

The number of thermal insulating materials suitable for greater than 2000°C operation in H_2 is extremely limited. Data obtained on a series of refractory metal carbide–refractory metal oxide composites developed for this purpose are presented. The basis for the excellent insulating characteristics of these composites is the formation of an oxycarbide having the general formula $MM'C_xO_y$, where M and M′ may be selected from the group consisting of titanium, zirconium, hafnium, vanadium, niobium, tantalum, thorium, and uranium. (auth)

6137 (LA–5140-MS) IMPROVED THERMAL-SHOCK-RESISTANT CARBIDES. Riley, R. E.; Taub, J. M. (Los Alamos Scientific Lab., N. Mex.). Feb 1973. Contract W-7405-eng-36. 7p. Dep. NTIS $3.00.

The thermal-stress resistance of refractory-metal carbides is substantially improved by addition of chopped metal fibers. The thermal-stress resistance of a composite consisting of 50 vol % TaC-50 vol % chopped Ta wire is approximately 40% greater than that of pure TaC. At temperatures above 2500°C, a composite material of this type will still crack, but the presence of the fibers inhibits the propagation of the cracks completely through the structure so that fracturing is prevented or substantially reduced. (auth)

6138 (NAA-SR–8617(Vol.2)) SNAP TECHNOLOGY HANDBOOK. Volume II. Hydride Fuels and Claddings. Burdi, G. F. (ed.) (Atomics International, Canoga Park, Calif.). 15 Nov 1964. Contract AT(11-1)-GEN-8. 129p. Dep. NTIS $8.50.

Declassified 24 May 1973.

Property data are presented on zirconium and yttrium hydride fuels and associated cladding (Hastelloy N, X, and R-235, Rene 41, T D Nickel, and TZM) and coating materials. Also included is a brief description and status summary of SNAP 2, 8, and 10A fuel elements. (auth)

6139 (SC-RR–720924) ELASTIC-PLASTIC POISSON'S RATIO OF BORSIC-REINFORCED ALUMINUM COMPOSITES. Allred, R. E. (Sandia Labs., Albuquerque, N. Mex.). Dec 1972. 40p. Dep. NTIS $4.00.

Poission's ratio as a function of tensile strain was examined for four volume fractions of unidirectional Borsic-reinforced aluminum composites. Linear relationships were found between Poisson's ratio and fiber volume fraction during Stage I (elastic filaments-elastic matrix) and Stage II (elastic filaments-plastic matrix) deformation which confirms that rule-of-mixtures equations may be used to predict Poisson's ratios for metal-matrix composites. A significant difference was found, however, between the Poisson's ratio behavior of the unreinforced matrix and the reinforced matrix as determined in situ in the composite. This difference is attributed to the triaxial stress field generated in the composite during deformation. The marked increase in the Poisson's ratio of the composite matrix upon yielding causes an abrupt rise in the slope of the composite Poisson's ratio versus longitudinal strain curve. This sudden increase may be used as an accurate method of determining matrix yield in filament-reinforced, metal-matrix composites. (auth)

6140 THEORY AND TECHNOLOGY OF PRODUCING MATERIALS OF ELECTRODE-INSTRUMENTS FOR ELECTRIC-EROSION TREATMENT. Communication 6. Electric Erosion of Transition Metal Carbides. Samsonov, G. V.; Mukha, I. M.; Globa, L. V. (Kiev Factory Radio Instrumentation). Porosh. Met., Akad. Nauk Ukr. SSR; No. 1, 44-40(Jan 1973). (In Russian).

Changes of electric erosion of transition metal carbides is considered in relation to the character of chemical bond in carbides and value of impulse energy during electric-spark treatment and treatment in glow discharge. It is shown that with the decrease of rigid Me–C bonds in carbides of transition metals and on increase of energy of electrolytic impulses, the mechanism of brittle destruction predominates. (auth)

6141 PRODUCTION AND PROPERTIES OF Nb–Al_2O_3 FILMS. Osipov, K. A.; Borovich, T. L. Izv. Akad. Nauk SSSR, Metal.; No. 5, 180-183(1972). (In Russian).

A method was developed for producing films of a Nb–Al_2O_3 mixture by condensing their vapors on glass supports at 400°C at a rate of 200 to 2000 Å/min. Films were thus produced varying in thickness from 0.07 to 1.2 μ, with a specific electrical resistance of from 2.0 to 8×10^8 ohm · cm. Their temperature coefficients ranged from -2×10^{-3} to -9×10^{-3} 1/degree. (KSW)

6142 DEVELOPMENT OF TECHNOLOGICAL PROCESS FOR OBTAINING COMPACT CERMETS BY MEANS OF IMPREGNATION OF POROUS BLANKS WITH LOW-MELTING IRON–BORIDE ALLOYS. Mashkov, A. K.; Chernienko, V. V.; Gutkovskaya, Z. P. (Omsk Polytechnic Inst., USSR). Porosh. Met., Akad. Nauk Ukr. SSR; No. 1, 38-43(Jan 1973). (In Russian).

The results are presented of experimental investigation of impregnation of cermet on iron base with eutectic iron–boride alloys. It is shown that pressed parts of mixtures of powders of iron and boron or borides of transition metals may be used as materials for impregnation of porous iron. Optimal conditions of hydrostatic pressing, sintering, and impregnation of porous pressed parts and blanks of iron in vacuum and in hydrogen medium are established. (auth)

6143 INFLUENCE OF FLAME COMPOSITION ON THE GROWTH OF SINGLE CRYSTAL Nb_2O_5 BY THE VERNEUIL METHOD. Valcic, A. V.; Brekic, M. G. (Faculty of Tech. and Metallurgy, Belgrade). Bull. Soc. Chim. Beograd; 36: No. 3-4, 149-152(1971). (In Serbo-Croatian).

The influence of the flame composition on the change of color of growing single-crystal Nb_2O_5 was investigated. It was found that the color of the single-crystal Nb_2O_5 turned from yellow to amber and finally to blue, in relation to the ratio H_2O_2 in the flame. The optimal conditions of growth of the single crystal Nb_2O_5 were found, and the produced single crystals were of length 20 to 30 mm and diameter 3 to 5 mm. (auth)

6144 DISSOCIATION PRESSURE IN THE YTTRIUM–HYDROGEN SYSTEM. Fadeev, V. N. Izv. Akad. Nauk SSSR, Metal.; No. 5, 210-214(1972). (In Russian).

The equilibrium pressure of H_2 above Y hydride was determined in the composition range H/Y = 0.2 to 1.90 and the temperature interval 600 to 1000°C. Points of inflection were noted in the isochores for the compositions H/Y = 0.3 to 1.4 at 920 to 770°C. Satisfactory agreement was obtained with literature values for ΔH_{diss} and ΔS_{diss} over the temperature interval studied. (tr-auth)

6145 EXCHANGE INTERACTION IN GdB_6 AND EuB_6 BY ELECTRON SPIN RESONANCE. Sperlich, G.; Janneck, K. H. (Technische Hochschule, Darmstadt, Ger.). Int. J. Magn.; 3: No. 1-3, 157-159(Sep 1972).

The linewidth of the ESR signal of metallic GdB_6 and semiconducting EuB_6 is, at room temperature, determined by exchange narrowing. The "exchange fields" for GdB_6 and EuB_6 are 65 and 25 kG, respectively. In GdB_6 the following values are obtained for the s–f exchange integral and the Fermi impulse: $|\Gamma|_{sf} = 0.05$ eV, $k_F \approx k_{FO}$. (auth)

6146 MAGNETIC CHARACTERISTICS OF SOME V_2O_5–MoO_3 SOLID SOLUTIONS. Ceausescu, N. N. (Univ., Bucharest); Mihalache, G.; Burzo, E. Rev. Roum. Phys.; 18: No. 2, 257-261(1973).

The susceptibility of V_2O_5 containing 2, 5, or 10 mole % MoO_3 was measured at 4.6 to 300°K. The temperature-dependent term (Curie type) of the susceptibility increases with MoO_3 content, and estimates are made of the number of V^{4+} paramagnetic centers. (DLC)

6147 DIMENSIONS OF RELAXATION REGION AROUND MIGRATING SINGLE VACANCIES IN CRYSTALS. Osipov, K. A. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR; 208: No. 5, 1065-1066(11 Feb 1973). (In Russian).

The theoretical significance of the activation energies of migration of point defects in crystals depend on the dimensions of the regions of relaxation around these defects. The effective volume, V, of such relaxation regions is evaluated for a number of metals, including Ag, Au, Cr, α-Fe, Mo, Na, Pb, and W, using the formula $V = 2E\mu/\tau^2$ where E is the activation energy of migration of a single vacancy, μ is the shear modulus, and τ is the theoretical shearing stress. (KSW)

6148 PHASE EQUILIBRIA IN THREE-COMPONENT ALLOYS CONTAINING AN INTERSTITIAL ELEMENT AND STABILITY OF COMPOSITE MATERIALS. Shurin, A. K. (Inst. of Metal Physics, Moscow). Porosh. Met., Akad. Nauk Ukr. SSR; No. 1, 50-53(Jan 1973). (In Russian).

On the basis of analysis of 200 three-component equilibrium diagrams for two transition metals and one interstitial element as well as from comparison of physicochemical properties of these metals and their compounds with interstitial elements the classification is proposed for the three-component equilibrium diagrams (separation into 4 groups). The analysis is given for alteration of phase state in composite metal materials when the equilibrium state is established there at high temperatures. The conditions for choosing of three-component systems are determined for the case where the chemical interaction between basic metal and interstitial phase is minimum in solid state at high temperatures. (auth)

6149 DETERMINATION OF THE BOUNDARY OF FLUORITE-LIKE SOLID SOLUTIONS OF Y_2O_3 IN HfO_2. Sukharevskii, B. Ya.; Gavrish, A. M.; Zoz, E. I.; Solov'eva, A. E. (Physical-Technical Inst. of Low Temperatures, Moscow). Dokl. Akad. Nauk SSSR; 208: No. 5, 1086-1088(11 Feb 1973). (In Russian).

Lattice parameters of the cubic solid solutions in the system HfO_2–Y_2O_3 were measured after annealing samples for 50 h at various temperatures ranging from 2025 to 2375°K. Quantitative x-ray analyses yielded data on the phase composition diagram and thence on the boundaries of the monoclinic, tetragonal, and cubic solid solutions. (KSW)

6150 SEMICONDUCTOR–METAL TRANSITIONS IN NbO_2 AND $Nb_{1-x}V_xO_2$. Rao, C. N. R.; Rao, G. R.; Rao, G. V. S. (Indian Inst. of Tech., Kanpur). J. Solid State Chem.; 6: No. 3, 340-343 (Mar 1973).

NbO_2, $Nb_{0.98}V_{0.02}O_2$, and $Nb_{0.95}V_{0.05}O_2$ transform from semiconducting to metallic state at temperatures higher than the DTA phase-transition temperatures. Vibrational mode softening and c-axis Nb–Nb pairing appear to be important factors in the mechanism of these transitions. In the solid solutions, c/a ratio is maximum at x = 0.5 since the metal–metal interaction along the c axis becomes minimum; conductivity is minimum at this composition since there are no mobile electrons. (auth)

6151 ION DAMAGE IN SYNTHETIC QUARTZ. Comer, J. J.; Bergeron, C.; Lowe, L. F. (Air Force Cambridge Research Labs., Bedford, MA). Mater. Res. Bull.; 8: No. 5, 505-513(May 1973).

Synthetic quartz was exposed to 3-MeV N^+ ions at fluences ranging from $4 \times 10^{13} N^+/cm^2$ to $2 \times 10^{16} N^+/cm^2$ and was then examined by transmission electron microscopy. Electron micrographs revealed the presence of defect clusters and selected area diffraction showed a loss in crystallinity with increasing ion fluence. The extent to which these defects could be removed by annealing depended upon the ion fluence. Dauphiné twins which formed upon cooling from temperatures above the alpha–beta inversion temperature were smaller and more numerous than in the undamaged material. After annealing to 790°C and cooling, the twins which formed were larger because of removal of much of the damage. 7 figures. (auth)

6152 STRUCTURAL ASPECTS OF THE METAL–INSULATOR TRANSITION IN V_4O_7. Marezio, M.; McWhan, D. B.; Dernier, P. D.; Remeika, J. P. (Bell Telephone Labs., Murray Hill, NJ). J. Solid State Chem.; 6: No. 3, 419-429(Mar 1973).

V_4O_7 has a transition with decreasing temperature at 250°K and the structure was refined at 298 and 200°K. The triclinic structure ($A\bar{1}$) consists of rutile-like layers of VO_6 octahedra extending indefinitely in the a–b plane and four octahedra thick along the c-axis. The average V–O distances for the four independent V atoms are 1.967, 1.980, 1.969, and 1.984 Å at 298°K and 1.948, 1.992, 1.961, and 2.009 Å at 200°K. At 200°K, there is a clear separation into strings of V^{3+} or V^{4+} ions running parallel to the pseudorutile c-axis. In addition, all of the 3+ and half of the 4+ sites are paired to form short V–V bonds. The remaining V^{4+} atom is displaced toward one oxygen so as to balance its electrostatic charge. The distortion at the metal–insulator transitions in V_4O_7, Ti_4O_7, VO_2 + Cr, and NbO_2 is compared. 7 tables, 5 figures, 27 refs. (auth)

6153 PHASE EQUILIBRIA IN THE SYSTEM $NbO_2-Nb_2O_5$: PHASE RELATIONS AT 1300 AND 1400°C AND RELATED THERMODYNAMIC TREATMENT. Kimura, S. (National Inst. for Researches in Inorganic Materials, Ibaraki, Japan). J. Solid State Chem.; 6: No. 3, 438–449(Mar 1973).

Phase equilibria in the system $NbO_2-Nb_2O_5$ at 1300 and 1400°C were studied and the variations of composition of solid oxide phases with oxygen pressure in the atmosphere were determined by using CO_2/H_2 gas mixture. Five discrete compounds, $Nb_{12}O_{29}$, $Nb_{22}O_{54}$, $Nb_{47}O_{116}$, $Nb_{25}O_{62}$, and $Nb_{53}O_{132}$ were observed to exist between NbO_2 and Nb_2O_5 at both temperatures. No appreciable tendency of increase of existence region was found for any of the studied compounds at higher temperatures. A mean for thermodynamic treatment of crystallographic shear planes including Wadsley intergrowth defects is proposed and, as a consequence, it was shown that Wadsley intergrowth defects in the studied compounds are probably of nonequilibrium nature. 5 tables, 6 figures, 20 refs. (auth)

6154 METAL–SEMICONDUCTOR TRANSITION IN $Mo_xV_{1-x}O_2$ CRYSTALS. Prodan, A.; Marinkovic, V.; Prosek, M. (Univ., Ljubljana, Yugoslavia). Mater. Res. Bull.; 8: No. 5, 551-558 (May 1973).

$Mo_xV_{1-x}O_2$ whiskers were prepared by slow reduction of V_2O_5 melts containing MoO_2. According to differential thermal analysis, resistivity, magnetic susceptibility, and x-ray measurements, partial substitution (up to $x \approx 0.035$) of V^{4+} ions by Mo^{4+} ions reduces the transition temperature and latent heat, as well as the conductivity and magnetic susceptibility ratio at the transition, while the transition disappears completely for $x \gtrsim 0.035$. The experimental data are in agreement with expectations of the dependence of transition characteristics on molybdenum concentration in $Mo_xV_{1-x}O_2$ samples. (auth)

6155 METHODS OF MAKING NUCLEAR FUEL COMPACTS. Cox, G. T. (to United Kingdom Atomic Energy Authority). British Patent 1,301,880. 4 Jan 1973. Filed date 29 Dec 1970. 4p.

Reference is made to methods of making nuclear fuel compacts composed of fission-product retaining fuel particles dispersed in a matrix material. Such compacts have been made hitherto by mixing measured quantities of particles and matrix material to form a homogeneous mixture, or by overcoating individual particles with matrix material. Both processes involve pressing the agglomerated materials, with risk of damage to the particles. In the method described a filler material and a polymerizable binder are used. A green compact is first formed by depositing the filler material and the binder in a mold in successive layers, and inserting into each layer a monolayer of fuel particles; having completed the compact the binder is polymerized to form the green compact into a coherent body. (UK)

6156 FUSED SALT PROCESS FOR PRODUCING RARE EARTH OXYCHLORIDE, OXYBROMIDE, AND OXIDE MATERIALS. Rabatin, J. G. (to General Electric Co.). British Patent 1,279,426. 28 Jun 1972. Filed date 9 Oct 1969. 5p.

The process described involves the following steps: (a) heating a mixture of the oxide of the rare earth or yttrium and the appropriate ammonium halide at 400 to 500°C for a time sufficient to form the oxyhalide in a poorly crystalline state; and (b) heating the oxyhalide with the appropriate alkali halide at 800 to 1200°C for a time sufficient to recrystallize the oxyhalide. An alkali carbonate may be added to the starting materials in step (a) to react with the ammonium halide to form the alkali halide of step (b). The starting material may also contain Ce, Pr, Nd, Sm, Eu, Tb, Dy, Ho, Er, or Tm as activator to cause the material to luminesce under excitation. (UK)

6157 FREQUENCY CHARACTERISTICS OF ANODIC OXIDE FILMS ON TANTALUM. Lee, D. N. (Korea Inst. of Science and Tech., Seoul); Yoon, Y. K. J. Korean Nucl. Soc.; 5: No. 1, 30–37 (Mar 1973).

Nishitani's equations for impedance of anodic oxide films were derived based on a p–i–n model under the assumption of $\omega\epsilon\rho_0 \ll 4\pi \ll \omega\epsilon\rho_\omega$, where ω is angular frequency, ϵ is dielectric constant, and ρ_0 and ρ_ω are the resistivity of the interface region and the intrinsic region of the anodic oxide film, respectively. Since it is not possible to evaluate all parameters in the equations, however, any clear physical picture cannot be obtained from the equations. Therefore, the equations are modified under the assumption of $\omega\tau_\omega \gg 1$ and $\ln(1 + \omega^2\tau_0^2) \ll 1$, where $\tau_\omega = \epsilon\rho_\omega/(4\pi)$ and $\tau_0 = \epsilon\rho_0/(4\pi)$. The modified equations are then used to explain the change in the frequency characteristics of anodic oxide films when they are heated. The change in impedance of anodic oxide films when they are heated is attributed mainly to the increase in the diffusion layer and to the decrease in the resistivity of anodic oxide films. (auth)

6158 MONOCHROMATIC EMITTANCE OF A TiC–ZrC SYSTEM. Kirillov, V. S.; Safonov, V. I.; Tychina, V. V. High Temp. (USSR) (Engl. Transl.); 10: No. 4, 814-816(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 4, 902-905 (1972).

The monochromatic emittance of a (TiC)x–(ZrC)1-x system was measured at 1800°K. Results are tabulated and compared with published data. (JRD)

6159 GROWTH OF SINGLE CRYSTALS OF CADMIUM OXIDE BY INOCULATION OF THE VAPOR–GAS PHASE. Ivanov, G. A.; Savitskaya, Ya. S. (Inst. of Radiotechnics and Electronics, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 11, 1705-1708(Nov 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 11, 1938-1942(Nov 1972).

A method of growing single crystals of CdO from the gas phase onto seeds by reacting Cd vapor with oxygen permits simultaneous growth of perfect crystals with good faces, 6 × 5 × 4 mm in size, of somewhat varied shapes (cubes, octahedra, and prisms), in 8 h. The influence of various experimental parameters on the crystallization and morphology of the CdO crystals was studied. An explanation of the experimental fact that the seeds dissolve at bulk supersaturations greater than unity but less than a critical value is given. (auth)

6160 ANALYSIS OF THE CONDITIONS FOR GROWTH OF SINGLE CRYSTALS OF CADMIUM OXIDE FROM THE VAPOR–GAS PHASE. Ivanov, G. A.; Savitskaya, Ya. S. (Inst. of Radiotechnics and Electronics, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 11, 1709-1712(Nov 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 11, 1943-1946(Nov 1972).

An equation is derived relating the surface and bulk supersaturations in terms of the kinetic parameters of the crystallization of CdO during synthesis from the vapors of its elements in a current of carrier gas. Analysis of this equation explains the observed dependence of the critical bulk supersaturation at which seed growth begins on the crystallization conditions, and gives the critical surface supersaturation, which is equal to 1.2 ± 0.15. It is shown that a qualitative criterion of the conditions for the formation of perfect crystals of CdO (or other $A_{II}B_{VI}$ compounds obtained by a similar method) is supplied by the quantity γ, which characterizes the ratio of the rate of supply of the components to the surface of the growing crystal to the rate of the chemical reaction of formation of CdO, (or the corresponding compound). Increase in γ leads to the production of perfect crystals. (auth)

6161 REACTION OF NITROGEN WITH NIOBIUM–ZIRCONIUM ALLOYS. Elyutin, V. P.; Maksimov, D. G: Mozzhukhin, E. I. Izv. Akad. Nauk SSSR, Metal.; No. 6, 64-68(1972). (In Russian).

The influence of 1 to 2% of Zr on the N–Nb reaction was studied in the region of single-phase solid solutions of alloys of Nb–Zr–N at temperatures of from 1600 to 1950°C. The observations of Siverts for pure Nb were confirmed and negative deviations from the law of ideal dilute solutions were noted in the Nb–Zr system. (KSW)

6162 LOW-TEMPERATURE REDUCTION OF THE OXIDES OF MOLYBDENUM AND TUNGSTEN. Uvarova, I. V.; Panichkina, V. V.; Konchakovskaya, L. D. Izv. Akad. Nauk SSSR, Metal.; No. 4, 86-91(1972). (In Russian).

The reduction of pure MoO_3 and WO_3 by hydrogen to intermediate oxides, both with and without the addition of 0.1 wt % Pd, was studied from about 200 to 1200°C. The addition of Pd lowered the temperature of reduction of MoO_3, but did not affect that of WO_3. The low-temperature reduction of WO_3 did not form WO_2, but the phase W_3O was detected by x-ray structure studies. (KSW)

6163 CRYSTALLIZATION OF THE $KY(WO_4)_2$ PHASE IN THE SYSTEM $Y_2O_3-K_2O-WO_3$. Kozeeva, L. P.; Klevtsov, P. V. (Inst. of Organic Chemistry, Novosibirsk, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 11, 1722-1725(Nov 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 11, 1958-1962(Nov 1972).

Potassium–yttrium tungstate is formed in the system Y_2O_3–K_2O–WO_3 via potassium tetratungstate. It has been found that among potassium polytungstates, $K_2W_2O_7$ is the best solvent for KY tungstate. The optimal conditions for spontaneous crystallization of KY tungstate from a solution in a potassium bitungstate melt are close to the following: a 1 : 2 ratio of $KY(WO_4)_2$ to $K_2W_2O_7$, temperature range 1100 to 700°C, cooling rate ≤3 deg/h, and isothermal holding time not less than 5 h. (auth)

6164 REACTION OF ZIRCONIUM DIBORIDE WITH MOLYBDENUM. Ordan'yan, S. S.; Serbezova, R. Ya.; Lebedeva, T. A. (Leningrad Technological Inst.). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 11, 1792-1793(Nov 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 11, 2037-2038(Nov 1972).

Alloys of ZrB_2–Mo were obtained from zirconium diboride, synthesized at 1700°C in vacuum from zirconium iodide (99.9%) and crystalline boron (99.3%), and molybdenum metal (99.7%). Specimens for high-temperature treatment were obtained from well-mixed ZrB_2 and Mo by drawing and were roasted at 1700 to 2000°C for 2 to 4 h in vacuum. Initial melting points in holes simulating an absolute black body were determined for all alloys determined. X-ray and metallographic analyses are discussed. It was ascertained that the phase diagram of the quasibinary system ZrB_2–Mo must be constructed according to the eutectic type, and the composition is of the eutectic being ~70 wt % (47.71 at. % Mo) and its temperature 2060 ± 20°C. (JCW)

6165 DIELECTRIC DISPERSION OF IRRADIATED $BaTiO_3$ IN THE PHASE-TRANSITION REGION. Dem'yanov, V. V.; Solov'ev, S. P. (Scientific-Investigation Physical-Chemical Inst., Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 11, 1802-1804(Nov 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 11, 2047-2049(Nov 1972).

The small-signal dielectric constant and dielectric loss of polycrystalline $BaTiO_3$ in relation to the integral flux of fast neutrons (>0.1 MeV) were investigated in the range from 10^4 to 1.5×10^{10} Hz. The cylindrical specimens were irradiated both with and without electrodes. It is shown that irradiation with fast neutrons leads to a shift in the Curie point to lower temperatures to a radiation-induced phase transition from the tetragonal phase to the paraelectric state. The shift in the Curie point is marked when the integral flux of fast neutrons is $>10^{18}$ cm^{-2}. It is also shown that a qualitatively similar change in the crystal lattice parameters of the $BaTiO_3$ is dependent on temperature and neutron flux. (JCW)

6166 COPRECIPITATED MIXTURES OF CALCIUM CARBONATE AND ZIRCONIUM HYDROXIDE. Galkin, Yu. M.; Ritman, D. S.; Toropov, Yu. S.; Matveichuk, G. S. Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 11, 1744-1747(Nov 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 11, 1985-1989(Nov 1972).

The results of an investigation of Ca carbonate and Zr hydroxide coprecipitated from solutions with molar ratio $CaO : ZrO_2 \leq 0.65$ are given. They do not form independent phases. It is postulated that complex carbonates of Zr and Ca are formed during this process. Regardless of the component ratio, their thermal decomposition is accompanied by formation of a single crystalline phase, cubic ZrO_2, which is a solid solution of CaO in ZrO_2. Despite the formation of an intermediate crystalline phase, synthesis of $CaZrO_3$ from coprecipitated mixtures is virtually completed at 1000 to 1100°C. (auth)

6167 ELECTRON PARAMAGNETIC RESONANCE OF RARE EARTH IONS IN CALCIA STABILIZED ZIRCONIA: Gd^{3+} AND Yb^{3+}. Bacquet, G.; Dugas, J.; Escribe, C.; Fabre, F. (Univ., Toulouse). J. Phys., C (London); 6: No. 8, 1432-1443(26 Apr 1973).

The paramagnetic resonance spectra of Gd^{3+} and Yb^{3+} in annealed single crystals of calcia-stabilized zirconia were investigated in the X band. In both cases, sites of almost cubic symmetry with a weak axial deformation, the principal axis of which is directed along a ⟨100⟩ direction, were observed. In the case of Gd^{3+}, an extra rhombic field was detected. The linewidths were about 60 G for Yb^{3+} and about 40 G for Gd^{3+}. The constants g, B_2^0, B_2^2, B_4^0, B_4^2, B_4^4, B_6^0, and B_6^4 of the Gd^{3+} spin hamiltonian were obtained using second-order perturbation theory. The other B_6^m were not obtained, due to a strong overlapping of wide lines. For Yb^{3+} it was found that $g_\parallel = 3.4788 \pm 0.0005$ and $g_\perp = 3.4032 \pm 0.0005$. One third the trace of the g tensor is 3.4284, which is very near to the predicted value for a Γ_7 doublet. Hyperfine structure for the two odd isotopes was resolved with $\bar{A}^{171} = 2701 \pm 10$ MHz and $\bar{A}^{173} = 738 \pm 10$ MHz. The results support the conclusions of Carter and Roth (1967) concerning the existence of a disorder–order transformation of calcia-stabilized zirconia by annealing at 1000°C, and confirm the ordered arrangement they proposed for the 0^{2-} ions around the zirconia sites. The atomic arrangement and the presence of Ca^{2+} ions and oxygen vacancies near the defects can account for the anomalous linewidths observed. (auth)

6168 MEASUREMENTS OF THE SPUTTER RATE OF FUSED SILICA BOMBARDED BY ARGON IONS OF ENERGY 12 TO 32 keV. Edwin, R. P. (National Physical Lab., Teddington, Eng.). J. Phys., D (London); 6: No. 7, 833-841(1 May 1973).

Measurements were made of the sputter rate of fused silica by argon ions of energy 12 to 32 keV. Details of the experimental technique are described, particularly with regard to the elimination of systematic errors. The sputter rates were measured to an accuracy of better than ±10%, and the dependence on angle of ion incidence was determined. Results from other workers are summarized and compared with the new values. (auth)

6169 SOLVENT EXTRACTION PROCESS FOR PRODUCING LOW-NITRATE AND LARGE-CRYSTAL-SIZE PuO_2 SOLS. Lloyd, M. H.; Tallent, O. K.; Leuze, R. E. (to United States Atomic Energy Commission). U. S. Patent 3,715,317. 6 Feb 1973. Filed date 2 Jun 1971. 10p.

Low-nitrate plutonia sols having a NO_3/Pu mole ratio in the range 0.1 to 0.4 with average crystallite diameters of 30 to 80 Å can be produced when a sol is prepared by solvent extraction of a plutonium nitrate seeded with a plutonia sol. When the seeded sol is taken to dryness and heated for 10 to 120 minutes at a temperature in the range 190 to 230°C, nitrate removal occurs with concomitant crystallite growth. (Official Gazette)

6170 PRODUCTION OF NUCLEAR FUEL. Lefevre, R. L. R. (to United Kingdom Atomic Energy Authority). British Patent 1,300,990. 29 Dec 1972. Filed date 23 Dec 1970. 2p.

Reference is made to methods for the production of coated-particle oxide nuclear fuel. The method described comprises depositing a first pyrolytic carbon coating of high density on the fuel kernels, then depositing a second porous carbon layer onto the first layer, and finally depositing at least one further high-density carbon layer on the porous layer. A layer of SiC may also be used in the third step. The first carbon layer may be deposited by pyrolysis of a hydrocarbon gas at about 1300°C, and the porous layer similarly at a higher temperature. The third step may be conducted at about 1900°C. (UK)

6171 INTRINSIC LUMINESCENT DEFECTS IN 15R SiC INDUCED BY ION BOMBARDMENT AND ANNEALING. Choyke, W. J.; Patrick, L. (Westinghouse Research Labs., Pittsburgh). pp 218-222 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF 720713-.

Implantation of ions in 15R SiC induces luminescence spectra which change with annealing. Two spectra which are independent of the implanted ion persist to the highest annealing temperature 1700°C. One is attributed to divacancies because of its unusual temperature dependence, and the other to di-interstitials because of the number and intensity of high-energy localized modes. (auth)

6172 EFFECT OF WATER VAPOR ON FATIGUE BEHAVIOR OF AN ALUMINUM–BORON COMPOSITE. Smith, H. H.; Shahinian, P. (Naval Research Lab., Washington, DC). pp 499-505 of Corrosion Fatigue: Chemistry, Mechanics, and Microstructure. Devereux, O. F. (ed.). Houston, TX; National Association of Corrosion Engineers (1972).

From international conference on corrosion fatigue: chemistry, mechanics and microstructure; Storrs, Connecticut, USA (14 Jun 1971). See CONF-710603-.

In this investigation of the influence of water vapor on the fatigue characteristics of a 2024 Al–B composite, crack growth rate, and life in water vapor and vacuum were compared for the transverse and longitudinal filament orientations. Water vapor increased rate of crack growth and decreased life over that in vacuum by as much as a factor of 200. In comparison, the effects of water vapor on the fatigue properties of aluminum alloys are reported to be no greater than a factor of 10. An air atmosphere also increased crack growth rate owing presumably to its moisture content. Specimens with filaments longitudinally oriented did not fracture across the minimum section under the reversed bend loading. The cracks, usually after passing through several rows of filaments, were redirected through the matrix parallel to the filament axis. In contrast, cracks in the transverse-filament specimens advanced in a direct path through both filaments and matrix. Crack propagation rate in the specimens vibrated in the thickness direction fluctuated, appearing to decrease as the crack approached filaments, and to increase rapidly as it passed through the filament and re-entered the matrix. The dependence of fatigue crack growth rate in the composite on water vapor pressure is S-shaped, the growth rate being insensitive to pressure at very low and very high pressures. This behavior is similar to that reported on aluminum alloys and conforms to the gas adsorption model of environmental effects. A calculated critical pressure, above which crack growth rate is insensitive to pressure, agrees with the observed critical pressure within an order of magnitude. The very large effect of water vapor on the fatigue properties of the Al–B composite, compared to aluminum alloys, may be attributed to the sensitivity of the fracture strength of boron filament to water vapor, and not of the matrix–filament interface. (12 figures, 20 references) (auth)

6173 UO_2 DEPOSITION FROM ITS PLASMA. Kawabuchi, Katsuhiro; Magari, Saburo (Institute of Atomic Energy, Kyoto University, Kyoto, Japan). Appl. Phys. Lett. 22: No. 7, 336-336 (1 Apr 1973).

When a UO_2 anode (hollow cylinder) was sufficiently heated to evaporate by the electron current from a W cathode, a stabilized plasma occurred between the electrodes without feeding any plasma gases. Crystalline UO_2 was deposited on the unheated cathode from the plasma. The mechanism of the deposition may be compared to that of electrodeposition of metals and may be called "electrolysis of plasma" (auth)

6174 YTTRIUM NIOBATES. Golub, A. M.; Maksakova, R. V.; Rozhenko, S. P.; Savoshchenko, V. S. (Kiev State Univ.). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 11, 1718-1721(Nov 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 11, 1954-1957(Nov 1972).

Using solubility, conductometric, and potentiometric methods, the authors investigated the system $Y(NO_3)_3-KNbO_3(K_3NbO_4)-H_2O$ and showed that Y metaniobate and orthoniobate are formed in it. $Y(NbO_3)_3 \cdot 12H_2O$ and $YNbO_4 \cdot 6H_2O$ were isolated from the solution. Differential thermal and x-ray diffraction analyses of these compounds established that Y metaniobate is unstable and decomposes at 710°C to form a $YNbO_4$-based solid solution. The x-ray amorphous Y orthoniobate is converted to the crystalline form above 600°C. The electrical properties of $YNbO_4$ and its solid solution with Nb_2O_5 have been investigated. (auth)

6175 INTERCRYSTALLINE DISINTEGRATION OF RECRYSTALLIZED LOW-ALLOYED MOLYBDENUM ALLOYS. Danyushchenkov, I. A.; Drachinskii, A. A.; Kaverina, S. N.; Pisarenko, V. A.; Trefilov, V. I. (Inst. of Metal Physics, Kiev). Metallofizika; No. 43, 97-100(1972). (In Russian).

The causes of the transition from trans- to intercrystalline disintegration in Mo alloys with Ti, Zr, and C were investigated. The onset of the transition around the annealing temperature coincided with the beginning of dissolution of the carbides. In alloys with TiC, the transition occurred at 1300 to 1400°C; with ZrC, at 1800 to 1900°C; and with MoC, at 2100 to 2200°C. These differences were referred to the high-temperature stability of the separated second phase, in the decomposition of which, C atoms would segregate in the region of the grain boundary. (tr-auth)

6176 EFFECT OF GROUP VIII ELEMENTS ON TRANSITION TEMPERATURE OF MOLYBDENUM–CARBON ALLOYS FROM THE DUCTILE TO THE BRITTLE STATE. Abalikhin, A. V.; Belous, O. A.; Biryukova, T. A.; Danielyan, T. A.; Danilovtseva, O. B.; Zhomov, P. I.; Kuznetsova, V. A.; Kurganov, G. V.; Mal'tsev, M. V.; Minakov, V. N.; Trefilov, V. I.; Shchukin, A. A. (Inst. of Metal Physics, Kiev). Metallofizika; No. 43, 89-97(1972). (In Russian).

The influence of Fe, Co, and Ir on the structure and temperature of transition (T_x) to the brittle state of Mo–C alloys was investigated in the cast and recrystallized states. The introduction of an optimal amount of members of the Fe group raised T_x significantly—in the case of alloying with Ni and Ir, as much as 100 to 120°C. Segregation of C at the grain boundaries was also reduced. (tr-auth)

6177 HIGH-TEMPERATURE VOLATILIZATION OF HEAT-RESISTANT CERAMIC COATINGS ON METALS. Demchenko, N. S.; Smirnov, N. S.; Ivakhin, S. I. Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 10, 1591-1593(Oct 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 10, 1812-1814(Oct 1972).

Results of a petrographic study of structural changes in surface layers and bulk coatings of ceramic oxides on Pt foil are presented. It was found that volatilization of components from oxide materials at high temperatures depends on the viscosity and degree of ordering of their structure. (JRD)

6178 STRUCTURAL TRANSFORMATIONS IN GLASSES OF THE SYSTEM $BeO-Al_2O_3-SiO_2-MgO$. Dmitriev, I. A.; Khan, V. P. (Ural Polytechnical Inst., Sverdlovsk, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 10, 1601-1605(Oct 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 10, 1824-1829(Oct 1972).

Structural transformations in glasses of the system $BeO-Al_2O_3-SiO_2-MgO$ were investigated by means of thermographic and x-ray analysis. The conditions of formation of beryl in the glasses were established. The effect of admixtures of oxides of different metals on vitrification and crystallization of the glasses is discussed. The behavior of titanium dioxide in the glasses is investigated in detail. It is shown that in melts of the system $BeO-Al_2O_3-SiO_2$, vitrification is accompanied by demixing, and during heat treatment of the quenched glass a metastable hybrid phase crystallizes. (auth)

6179 EFFECT OF PENETRATING RADIATION ON THE DENSITY OF ELECTROVACUUM GLASSES. Fainberg, E. A.; Piterskikh, S. E. Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 10, 1609-1612(Oct 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 10, 1834-1838(Oct 1972).

Density changes in electrovacuum glasses, resulting from the action of various types of penetrating radiation were investigated. The mechanism of radiation damage responsible for the density increases of these materials is examined and discussed. (JRD)

6180 EVAPORATION OF SOLID SOLUTIONS $Zn_xCd_{1-x}Te$ AND $CdSe_xTe_{1-x}$. Ivanov, Yu. M.; Yukhtanov, E. D.; Mentser, A. N.; Vanyukov, A. V. (Moscow Inst. of Steel and Alloys). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 10, 1635-1636(Oct 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 10, 1860-1861(Oct 1972).

Evaporation mechanisms in these solid solutions were studied using mass spectrometric methods. Data on vapor compositions at 1050°K are tabulated for the Zn compounds and at 1000°K for the Se compounds. (JRD)

6181 CONCENTRATION DEPENDENCES OF HARDNESSES OF NONSTOICHIOMETRIC CARBIDES OF THE TRANSITION METALS OF GROUPS IV AND V. Bukatov, V. G.; Solov'ev, G. W. Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 10, 1637-1638(Oct 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 10, 1862-1863(Oct 1972).

Data on density and hardness versus concentration of valence electrons of carbides in these periods are presented showing that at the compositions under study the hardness varies as function of electron states at the Fermi level. (JRD)

6182 REACTIONS OF MoO_3 AND WO_3 WITH NiO, Al_2O_3, HfO_2, AND ZrO_2 DURING PREPARATION OF NICKEL ALLOYS BY POWDER METALLURGY. Timofeeva, E. N.; Kustov, Yu. A.; Beresten, N. E.; Romanovich, I. V. Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 10, 1648(Oct 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 10, 1872(Oct 1972).

The oxide powders were roasted in air at 400, 600, 800, and 1000°C for 25 h to establish the degree of sublimation and the character of the reaction; after roasting they were subjected to reducing annealing in hydrogen at 800 to 1000°C for 2 h, and the degree of homogenization of the solid solution was assessed by x-ray analysis. Results of the thermal treatments are described and analyzed. (JRD)

6183 PHYSICOCHEMICAL INVESTIGATION OF THE SYSTEM $Y_2O_3-Ta_2O_5$ AND SYNTHESIS OF SINGLE CRYSTALS OF A SERIES OF NIOBATES. Bondar, I. A.; Kalinin, A. I.; Koroleva, L. N. (Inst. of Silicate Chemistry, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 10, 1649-1650(Oct 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 10, 1873-1874(Oct 1972).

Phase equilibria in the system $Y_2O_3-Ta_2O_5$ is examined. The specimens were synthesized at 1200 to 1450°C; they were annealed and quenched in a platinum–rhodium furnace (up to 1700°C) or in a high-temperature microfurnace. A phase diagram of the system $Y_2O_3-Ta_2O_5$ was constructed from the data obtained. (auth)

6184 PHASE EQUILIBRIA IN THE SYSTEM $HfO_2-Dy_2O_3$. Perova, E. B.; Spiridonov, F. M.; Komissarova, L. N. (Moscow State Univ.). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 10, 1655(Oct 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 10, 1878(Oct 1972).

Phase relations in the system were investigated at 1000 to

1700°C by x-ray. The specimens were obtained by coprecipitation of the hydroxides with ammonia throughout the range of compositions at 1.5 to 2.5 mole % intervals. To investigate the reproducibility, the specimens were synthesized twice. The specimens were annealed at the appropriate temperatures and quenched. The phase diagram of the system $HfO_2-Dy_2O_3$ was constructed from the data obtained. The system comprised broad fields of solid solutions and two-phase regions. (JRD)

6185 MAGNETIC PROPERTIES OF SOLID SOLUTIONS IN THE SYSTEMS TiO-NiO, TiO-CoO, AND VO-NiO. Aivazov, M. I.; Gurov, S. V.; Sarkisyan, A. G. (Inst. of New Chemical Problems, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 10, 1584-1587(Oct 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 10, 1803-1807(Oct 1972).

The magnetic susceptibility of solid solutions in the systems TiO-NiO, TiO-CoO, and VO-NiO at 100 to 1000°K was investigated. It was found that the magnetic susceptibility increases with an increase in one of the solution components. In these solid solutions the susceptibility has a ferromagnetic component in the range 100 to 650°K. From the pattern of change in the magnetic susceptibility with the composition and increasing temperature, it is inferred that the tetrahedral interspacings in the NaCl-type structure are filled by cations; the degree of filling is very small and undetectable by x-ray analysis. (auth)

6186 MAGNETIC PROPERTIES OF SOLID SOLUTIONS IN THE SYSTEM VO-MnO. Aivazov, M. I.; Gurov, S. V.; Sarkisyan, A. G. (Inst. of New Chemical Problems, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 10, 1581-1583(Oct 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 10, 1799-1802(Oct 1972).

The magnetic susceptibility at 100 to 1000°K in solid solutions of the system VO-MnO was investigated. It was found that at room temperature there is a linear decrease in susceptibility with increasing VO content, accompanied by a fall in the number of unpaired electrons. (auth)

6187 CERMET CATHODE MATERIALS FOR ELECTROVACUUM DEVICES. Faifer, S. I.; Zhdanov, S. M.; Busol, F. I.; Zvonetskii, V. I.; Korzhavyi, A. P.; Morokov, V. I. Porosh. Met., Akad, Nauk Ukr. SSR; No. 2, 101-107(Feb 1973). (In Russian).

Cermet cathode alloys on the bases of refractory, precious and other metals with various active components were developed for electrovacuum devices; and their emission properties were studied. Materials of particular interest here are W-10% YB_4, Re-10% YB_4, and Re-10% CdB_4, for which the phase compositions, densities, and microhardness are given. (auth)

6188 INDENTOR MATERIALS FOR MEASURING HARDNESS AT HIGH TEMPERATURES. Dzhemelinskii, V. V.; Koval'chenko, M. S.; Makarenko, G. N. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 2, 97-100(Feb 1973). (In Russian).

Data are given on conditions for producing an alloy having a boron-carbide base with addition of titanium used as an indentor for measuring hardness of refractory borides and carbides at high temperatures. As a result of this test it is established that indentors of boron-carbon-titanium alloy with 5% by weight of Ti permit measuring hardness within a temperature range of 400 to 2000°C during one cycle of investigations. Indentor may be subjected to multiple resharpening without deteoriorating the quality of indents. (auth)

6189 THERMODYNAMIC APPROACH TO ANALYSIS OF DIFFUSIVE-CONTROLLED PROCESS IN INTERSTITIAL PHASES. Andrievskii, R. A. Porosh. Met., Akad. Nauk Ukr. SSR; No. 2, 76-81(Feb 1973). (In Russian).

A change in the rate of diffusively controlled processes in the domain of homogeneity of interstitial phases is considered by the methods of thermodynamics of irreversible processes. Expressions for heterodiffusion coefficients are obtained and analyzed in three-component introduction phases. The values of the thermodynamic factors in these compounds are estimated. Experimental and calculated diffusion coefficients are compared for alloys such as $ZrN_{0.86}$, and two types of $NbC_{0.96}$. Various thermodynamic quantities are tabulated for ZrC binary systems: 10% NbC, 10% HfC, and 10% TiC.

6190 HIGH-TEMPERATURE OXIDATION OF LANTHANUM HEXABORIDE. Voitovich, R. F.; Pugach, E. A. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 2, 71-75(Feb 1973). (In Russian).

Oxidation of compact LaB_6 samples was studied at 500 to 1200°C in the air. Thermodynamic calculation of equilibria in LaB_6-O_2 and LaB_6-N_2 systems was carried out, kinetic investigation, metallographic and x-ray phase analysis were also made, which enabled a conclusion to be drawn on the mechanism of oxidation and resistance of LaB_6 to oxidation. (auth)

6191 ELECTROPHORETIC METHOD OF PRODUCING COATINGS. Literature Survey. Apininskaya, L. M.; Furman, V. V. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 2, 61-64(Feb 1973). (In Russian).

The electrophoretic method is equally applicable to the application of coatings for conductors and dielectrics. Metals, alloys, oxides, refractory compounds, and polymers may be deposited by this method. The high rate of coating deposit (seconds to minutes) results from the high mass/charge ratio of the particles involved, as contrasted to electrolysis. Stable suspensions are difficult to achieve, however—a drawback to the electrophoretic method. An outline of individual techniques is appended for the production of coatings of Al, Nb, Al, W, WC + TiC + NbC + TaC + B + Co, $MoSi_2$ + Ni, MoS_2 + Cu, BN + Cu + Ni, NiO + TiC, $BaSrCa(CO_3)_8$ + ZrO_2, and U_3O_8. (17 references) (KSW)

6192 BORON CARBONITRIDE: A HIGH-TEMPERATURE ELECTRIC INSULATING AND REFRACTORY MATERIAL. Samsonov, G. V.; Eroshenko, A. I.; Ostroverkhov, V. I.; Krat, V. A.; Dubovik, T. V. (Inst. of Materials Science, Kiev). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 12, 985-986(Dec 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 12, 46-48(Dec 1972).

Electrical, thermal, evaporation, and mechanical properties of boron carbonitride are tabulated for temperatures up to 2000°C. Its refractory properties (it can operate up to 3000°C in N_2) are described. Some of its applications as an electric insulating material are described; it has the highest resistance to attack by fused borax at 950°C. (DLC)

6193 PRODUCTION OF NICKEL-BASE-ALLOY POWDER FROM CUTTINGS. Borok, B. A.; Rybal'chenko, M. K.; Labrent'ev, I. A.; Shchegoleva, R. P.; Golubeva, L. S.; Volobuev, V. F. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Porosh. Met., Akad. Nauk Ukr. SSR; No. 2, 20-27(Feb 1973). (In Russian).

The production technique developed includes oxidation of the cuttings and reduction of the obtained scale in two stages; by hydrogen and calcium hydride. The powders possess good technological properties and may be used for production of porous and compact articles and materials by powder metallurgy. Nearly all of the Ni alloys tested included about 4% Mo and 5% W in each composition. (auth)

6194 EPR STUDY OF RADIATION-INDUCED MIGRATION AND STABILIZATION OF ALKALI IONS IN GERMANIUM-DOPED QUARTZ. Lorenze, R. V. Jr. Bethlehem, PA; Lehigh Univ. (1972). 123p. University Microfilms Order No. 73-10,940.

Thesis (Ph. D.).

The effects of x rays on single crystals of synthetically grown germanium-doped quartz were investigated via EPR techniques. Three previously unreported paramagnetic absorptions (designated as β_1, β_2, and β_3), exhibiting dominant quartet hyperfine structure, were studied in detail. Spectroscopic experiments showed that the β centers are: (1) basically similar in composition and structure, (2) related to germanium impurities, and (3) incorporate more than one interstitial alkali metal ion. Kinetic studies, in which the relative concentrations of selected paramagnetic centers were monitored as a function of specimen treatment (x-irradiation or heating), showed that the observed radiation bleaching of singly alkali metal-compensated germanium trapped electron centers could be related to formation of the β centers. Subsequent rate equation analysis of the radiation kinetic data indicated that the β centers incorporate three interstitial charge compensating alkali metal ions (β_1 and β_2 incorporate both Li and Na ions; β_3 (incorporates only Na ions), and are formed by a radiation-induced consecutive trapping of electrons at Ge sites. In this kinetic model, the singly compensated Ge centers serve as precursors for the β centers, with the formation of the latter critically dependent upon the ability of the alkali metal ions to migrate through the quartz lattice. (Diss. Abstr. Int., B)

6195 POROUS CARBIDES AS EVAPORATION SOURCES FOR VACUUM DEPOSITION OF METAL AND SEMICONDUCTOR LAYERS. Ploos van Amstel, J. J. A.; Kool, E. (Phillips Research Labs., Eindhoven, Netherlands). J. Electrochem. Soc.; 120: No. 6, 840-843(Jun 1973).

Long porous evaporators consisting of the carbides of either Al, Si, Ti, or Zr can be prepared by reaction of these elements with commercially available graphite cords. The resulting evaporators are rod or tube shaped and may contain a fairly large amount of material to be evaporated. Connection to a continuous supply system is possible as capillary action causes a rapid distribution of molten material along the evaporator (7 figures) (auth)

6196 ELECTRONIC MECHANISM OF BASIC TECHNOLOGICAL PROCESSES IN POWDER METALLURGY OF HIGH-TEMPERATURE MATERIALS. Samsonov, G. V.; Upadhyaya, G. S. (Inst. of Materials Science, Kiev). Planseeber. Pulvermet.; 20: No. 4, 269-284(Dec 1972).

Progress in the field of basic powder metallurgical processes has so far been based mainly on physical or physicochemical concepts. The complete picture is reviewed on the basis of the stable electronic configuration model of the condensed state. Metal powder production by the reduction method can be visualized as a donation of electrons from the reducing agent to the metal ions; the reduction rate naturally depends on the electron donor capacity. During pressing of metal powders, apart from macroscopic and microscopic changes, there is sufficient scope for electronic exchange between the excited atoms and this suggests a very great similarity between the processes of pressing and sintering. Numerous attempts at theoretical interpretations of the sintering mechanism viz., chemical reactions of the surface and boundaries of particles, surface and volume diffusion, thermally activated dislocation processes, have achieved some success, but only in the interpretation of phenomena typical for individual sintering stages. However, the model presents the different sintering stages in a coherent picture. Various examples have been adduced from the field of powder metallurgy of the refractory metals and their compounds in order to justify the unified approach of the electronic configuration model. (36 references) (auth)

6197 NATURE OF CEMENTED CARBIDES. Jurca, S. (Inst. of Metallurgy, Ljubljana, Czech.). Planseeber. Pulvermet.; 20: No. 4, 285-298(Dec 1972).

Processes involved in sintering Cr_3C_2 with Ni were studied. Results are the basis for a conclusion that the elastic modulus of a material is an intrinsic property, i.e., a property that cannot be changed to any considerable extent. Since tungsten carbide has the highest known elastic modulus, apart from diamond, it is not possible to create a better cemented carbide. What remains is the possibility to improve the existing materials. The latest results on titanium carbide as well as the improved transverse rupture strength of Cr_3C_2-Ni materials prove that there is still a large number of problems to be solved. (35 references) (JRD)

6198 EFFECTS OF CARBIDE COMPOSITION ON MICROSTRUCTURE OF CEMENTED BINARY CARBIDES. Warren, R. (Univ. of Surrey, Guildford, Eng.). Planseeber. Pulvermet.; 20: No. 4, 299-317(Dec 1972).

A study was made of the effects of the carbide composition on the microstructure of cemented carbide alloys of the mixed-carbide systems, VC–NbC, NbC–TaC, and TiC–WC, with a cobalt binder phase. The carbide grain shape, the degree of carbide grain contact and the carbide grain size that develop during the liquid-phase sintering of these alloys were very sensitive to the carbide composition. Additions of one carbide to another usually caused an increase in grain contact and a reduction in the grain growth. The inhibition of growth was particularly marked in those VC–NbC alloys that contained two separate carbide phases. Electron-probe microanalysis revealed that the coring, observed optically in carbide grains in the (Nb, Ta) C–Co and (Ti, W) C–Co alloys, arose from variations in composition. This is attributed to a difference between the composition of the carbide grains in the original powders and the composition of the carbide that precipitates during sintering. (auth)

6199 EFFECT OF MIXED MILLING ON SINTERING OF WC–Co HARDMETALS. Lehtinen, B. (Swedish Inst. for Metal Research, Stockholm); Easterling, K. E. Planseeber. Pulvermet.; 20: No. 2, 141-151(Jun 1972).

Scanning electron microscopy, electron diffraction, and hot-stage high-voltage (1000 kV) electron microscopy are used to investigate the effect of mixed milling of WC-Co powders on the early stage sintering and particle rearrangement. It is found that the effect of mixed milling is both to impregnate Co grains with small WC grains, and to coat WC grains with a fine Co_3O_4 powder. It is shown that this fine powder coating may be important to the initial linking up of WC grains, which occurs in the early stages of sintering. (auth)

Metals and Alloys

Refer also to abstracts 6113 and 6709.

6200 (CONF-730402–(P1-2)) PROCEEDINGS OF THE TENTH RARE EARTH RESEARCH CONFERENCE, CAREFREE, ARIZONA, APRIL 30–MAY 3, 1973. Kevane, C. J.; Moeller, T. (eds.) (Arizona State Univ., Tempe). 1973. 1229p. (In English and French). Dep. NTIS $27.20.

About 152 papers and abstracts are arranged, in two volumes, under the following topics: lanthanide–actinide chemistry, industrial technology, magnetics, bio-inorganic chemistry, solid-state science, metals, NMR shift reagents, spectroscopy, and chemistry. Separate abstracts were prepared for 63 of the papers. Eleven of the papers were previously abstracted in NSA as 27: 26655–7, 27223, 27232, 22315, 22268, 22903, 23458, 24485, and 27447. (DLC)

For abstracts of individual chapters see: 5135–5137, 5214, 5215, 5245–5249, 5256, 5854, 6114–6127, 6201, 6202, 6209, 6221–6223, and 6245–6275.

6201 (CONF-730402–(P1-2), pp 26-33) PRODUCTION AND USES OF RARE EARTHS IN JAPAN. Oiwa, I. T. (Shinetsu Chemical Co., Tokyo). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Some of the problems faced by the rare earth industry in Japan are described: consumer market, pollution. Importation of raw materials and consumption and uses of rare earths in Japan are discussed. (2 tables, 3 figures) (DLC)

6202 (CONF-730402–(P1-2), pp 53-62) MILITARY USES OF MISCH METAL. Kulp, B. A. (Air Force Armament Lab., Eglin AFB, FL). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

The use of the rare earth metals as fire starters (incendiary munitions) is discussed. The historical development of solid pyrophoric materials is briefly surveyed. Other military uses of misch metal (marker, flechette, bomb, etc.) are also described, and comparisons with other incendiary materials are made. (DLC)

6203 (RDT-M-6-3-T(4-73)) ALLOY STEEL BOLTING MATERIAL FOR HIGH TEMPERATURE SERVICE (ASME SA-193 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Apr 1973. 11p. RSO.

A standard prescribing requirements for alloy steel bolting material for high temperature service (ASME-193) with additional requirements for nuclear and associated applications is presented. This standard supersedes RDT 6-3T, dated July 1971. (J.R.D.)

6204 (RDT-M-13-1-T(4-73)) SODIUM PURCHASE SPECIFICATIONS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Apr. 1973. 11p. RSO.

A standard prescribing requirements for sodium purchase specifications for nuclear and associated applications is presented. (JRD)

6205 TECHNIQUES INVOLVING EXTREME ENVIRONMENT, NONDESTRUCTIVE TECHNIQUES, COMPUTER METHODS IN METALS RESEARCH, AND DATA ANALYSIS. Bunshah, R. F. (ed.). Techniques of Metals Research, Volume VII, Part 1. New York; John Wiley and Sons, Inc. (1972). 537p.

This volume includes nine review articles on various techniques of metal research: property evaluation at ≤ 4°K, surface characterization (Auger electron spectroscopy, cylindrical emission microscopy, proton channeling), coating techniques (fused-salt diffusion and plasma-arc spraying), fabrication of composite materials, computer methods, and data evaluation and analysis. A separate abstract was prepared for each of the five articles in scope of NSA. (DLC)

For abstracts of individual chapters see: 6234–6236, 6374, and 6921.

6206 METALLURGY, CHEMISTRY, AND ELECTROCHEMISTRY OF REFRACTORY METALS. Reznichenko, V. A. Izv. Akad. Nauk SSSR, Metal.; No. 6, 5-18(1972). (In Russian).

A review of the technology of W, Mo, Re, Ti and TiO_2, their tonnage production in the major countries of the world, and an outline of pertinent chemistry are presented. 54 references. (KSW)

Corrosion and Erosion

Refer also to abstracts 5855 and 7337.

6207 (BNWL-SA-4668) STRESS CORROSION IN NUCLEAR SYSTEMS. Bush, S. H.; Dillon, R. L. (Battelle Pacific Northwest Labs., Richland, Wash.). 8 Mar 1973. 63p. (CONF-730605-2). Dep. NTIS $5.25.

Results of a literature search for information on stress corrosion in nuclear systems are presented. It was found that the two components most susceptible to stress corrosion are PWR steam generator tubes and BWR austenitic stainless steel (Type 304) piping. These two classes of components account for greater than fifty percent of the cases of stress corrosion cited. If thin-wall non-freestanding stainless fuel element cladding for BWR fuels is included, then virtually all austenitic stainless steel cladding is expected to fail well before expected fuel burnup is achieved. These failures occur by a stress assisted intergranular corrosion mechanism even when the cladding is not sensitized according to the usual definition. A review of the frequency of stress corrosion indicates that a greater frequency occurs in BWRs after about five years of operation. This trend is quite significant and may require special measures in future BWRs in addition to current procedures to reduce degree of weld HAZ sensitization and control of contaminants. It appears that stress corrosion will be of concern in future reactors including the LMFBRs. With the exception of fuel element cladding, the principal difference between a nuclear power plant and a fossil fuel power plant, the neutron flux, appears to have a relatively limited effect on the occurrence of stress corrosion. (90 references) (JRD)

6208 (CONF-720578-2) MATERIALS IN THE PRIMARY CIRCUIT OF WATER-COOLED POWER REACTORS. Debray, W.; Stieding, L. (Siemens A. G., Erlangen (West Germany)). [nd]. 25p.

From international nickel power conference; Lausanne, Switzerland (May 1972).

Selective corrosion in austenitic chromium-nickel steels, Inconel 600 and Incoloy 800 under the various service conditions obtaining in light-water reactors was studied. Particular reference is made to the phenomenon of intercrystalline stress corrosion. Results of corrosion tests are presented and these are discussed with reference to recent results obtained elsewhere and service experience with boiling water and pressurized water reactors. The adoption of Incoloy 800 as tubing alloy for steam-raising plant instead of Inconel 600 is described. Crack initiation during fabrication of low-alloy steel is also examined. The reason for this was the world-wide occurrence of so-called undercladding cracks in steels ASTM A 508 Grade 2 (22 NiMoCr 37) and ASTM A 533 Grade B Category 1. It is shown that this is a special form of stress-relief cracking to which this type of steel is susceptible. Investigations of such cracking are reported. It is proposed to introduce the concept of relaxation embrittlement as reason for such cracking. (auth)

6209 (CONF-730402-(P1-2), pp 43-52) EFFECT OF MICROSTRUCTURE ON CORROSION BEHAVIOR IN DILUTE MISCH METAL-Mg CASTINGS. Fishman, S. G.; Crowe, C. R. (Naval Weapons Lab., Dahlgren, VA). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30-May 3, 1973.

The corrosion resistance of the alloys is strongly structure-dependent and somewhat dependent on the Mg content. The sequence of phase transformations which occur in mischmetal-Mg alloys was investigated and the results correlated with weight loss and potentiostatic corrosion data. It was found that an increase in cooling rate radically alters the microstructure. Typically, investment-cast specimens exhibit a mixed microstructure with a divorced eutectic, proeutectoid crystals, and a lamellar eutectic as microconstituents. Permanent die-cast specimens exhibit a largely single-phase microstructure consisting of Widmänstatten needles. Permanent die cast or quenched specimens show less susceptibility to atmospheric attack than do the investment cast or slow-cooled specimens. The atmospheric attack increases with increasing percent relative humidity as expected for an atmospheric corrosion mechanism. In this case, the corrosion rate increases as a moisture layer builds up on a metal due to onset of galvanic action. The galvanic corrosion mechanism can be used to explain the observation that the slow-cooled specimens corrode at a greater rate than do the quenched specimens and that the lamellar phase in the slow-cooled specimens corrode at the greatest rate of all. Further indication of the greater corrosion resistance of the Widmänstatten needle microstructure is given by the similarity of potentiostatic curves of this alloy to those obtained for metals exhibiting active-passive transitions. (DLC)

6210 (KFK-1773) INFLUENCE OF COLD-WORKING ON THE CORROSION RESISTANCE OF AUSTENITIC CrNi-STEELS IN SUPERHEATED STEAM. 3. Static Autoclave Studies of the Material No. 1.4301 (X5 CrNi 18 9). Leistikow, S.; Pott, E.; Volz, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Mar 1973. 31p. (In German). Dep. NTIS (U. S. Sales Only) $3.75.

Cold-worked sheet specimens of an 18-9 CrNi-steel (AISI-304 ss) were tested in static high pressure steam autoclaves for runs of 1000 hours at 600°C and 70 atm. The experiment resulted in a substantial increase of corrosion resistance by the cold working and grain refining pretreatments which increased the defect concentration. Heat treatments, reducing the number of defects and forming coarse grain structures, decreased the corrosion resistance. The following oxidation mechanisms are considered to be effective: the thermodynamically favored chromium oxide and spinel layer formation by inward diffusion of oxygen ions, the dependency of the defect concentration on the selective chromium oxidation, the high diffusivity of chromium in a bulk structure of high defect concentration, especially in the grain boundaries, which are acting as easy diffusion paths, the extraordinary protective character of chromium-rich oxide layers preventing the outside diffusion of iron and nickel ions in a second oxide phase forming process. Thus, the cold working results in a decrease of the corroded metal concentration down to 17 mg/dm^2, whereas a 1-hour annealing at 1300°C increases this concentration up to 2,240 mg/dm^2. (GF)

6211 (LA-tr-73-10) PREPARATION OF ULTRA-FINE METAL POWDERS BY SPARK EROSION IN LIQUID INERT GASES. Ruppersberg, H.; Bold, H. J. Translated from Metall; 26: 34-38(1972). 14p. Dep. NTIS $3.00.

An apparatus is described in which metals are converted into powders by means of spark erosion under nonconducting liquids. The results of powdering Ni, Cu, Ag, Fe, Pb, Ca, Ti, Ce, Ag-Cu, and Cu-Ni in several liquids, especially argon and nitrogen, are described. The powder consists of a coarse portion (average particle size, several hundred μ) and a fine portion (average particle size, several hundred Å). The total yield was investigated with regard to its dependence upon several parameters and on the magnitude of 0.5 g per hour. Chemical reactions with the work liquid, increased degrees of faulty order, strong chemical reactivity, as well as separating and formation of metastable phases in the case of alloys, were observed. It seems possible for many metals to produce ultrafine powders by means of sparking in liquid argon. Titanium is an exception. But the powder should not be brought into contact with air, at least not immediately after the preparation. (auth)

6212 EFFECTS OF ENVIRONMENT ON MATERIAL PROPERTIES IN NUCLEAR SYSTEMS. Arch. Energiewirt.; 27: No. 1, 45-49(1973). (In German).

A survey is given on the corrosion, particularly stress corrosion of various materials which are in contact with the cooling medium of the cooling systems of water-, sodium- and helium-cooled reactors (such as Zircaloy, austenitic and ferritic steels, and nickel-rich alloys). Corrosion mechanisms are briefly described, which have already been discussed in the literature. (GF)

6213 SURFACE EFFECTS DURING FRETTING FATIGUE OF Ti-6Al-4V. Malkin, S.; Majors, D. P.; Courtney, T. H. (Univ. of Texas, Austin). Wear; 22: No. 2, 235-244(Nov 1972).

An investigation is described of surface effects which occur during fretting fatigue of Ti-6Al-4V alloy. A one-stage test procedure was used whereby fretting and fatigue occur simultaneously. Friction forces and contact resistances were measured during testing. Results were found to fall into two classifications: low-contact stress where fatigue failure initiates away from the fretting area, and higher-contact stress where fretting cracks initiate at the edge of the fretting area and propagate to failure. With the low-contact stress, slip occurs and wear particles become entrapped between the fretting surfaces, whereas with the higher contact stresses, no slip occurs and wear particles are not observed. Fatigue reduction with the high stress is attributed to localized fatigue due to the fretting stresses. The absence of fatigue failure at the fretting area with the low-contact stress is attributed to stress reduction by entrapped particles and removal of fatigued material by fretting wear. (auth)

6214 CORROSION FATIGUE: CHEMISTRY, MECHANICS, AND MICROSTRUCTURE. Conference Held at Storrs, Connecticut, June 14-18, 1971. Devereux, O. F.; McEvily, A. J.; Staehle, R. W. (eds.). International Corrosion Conference Series, NACE-2. Houston, TX; National Association of Corrosion Engineers (1972). 791p. (CONF-710613-).

From international conference on corrosion fatigue: chemistry, mechanics and microstructure; Storrs, Connecticut, USA (14 Jun 1971).

Seventy-four technical papers, together with discussions and a summary of the conference, are presented under the following headings: introduction; industrial problems; initiation processes (mechanical and physical, chemical aspects); fatigue crack propagation; phenomenological aspects; aluminum alloys; steels; elevated temperatures; fretting, cavitation, and rolling contact fatigue; cracking in polymeric solids; and cracking in glass. Author, subject, and discussion author indexes are included. Separate abstracts were prepared for five of the papers. (DLC)

For abstracts of individual papers see: 6172, 6215–6217, and 6376.

6215 CORROSION FATIGUE OF ASTM A-302B STEEL IN HIGH-TEMPERATURE WATER, THE SIMULATED NUCLEAR REACTOR ENVIRONMENT. Kondo, T.; Kikuyama, T.; Nakajima, H.; Shindo, M.; Nagasaki, R. (Japan Atomic Energy Research Inst., Tokai). pp 539-556 of Corrosion Fatigue: Chemistry, Mechanics, and Microstructure. Devereux, O. F. (ed.). Houston, TX; National Association of Corrosion Engineers (1972).

From international conference on corrosion fatigue: chemistry, mechanics and microstructure; Storrs, Connecticut, USA (14 Jun 1971). See CONF-710603-.

The high temperature water environment typical of a BWR reactor (without irradiation) has a substantial influence on the growth kinetics of fatigue cracks in ASTM A302B steel. The effect of strain or stress range on the fatigue crack growth rate is greater in high-temperature water than in ambient air. Considerable acceleration of crack growth occurs at higher stress intensity ranges; hence in a single fatigue process, the crack growth tends to be continuously accelerated as the stress concentrates with an increase in the length of cracks. Increasing temperature increases the crack growth rate up to 180 to 200°C, but above these temperatures, the opposite effect is observed. Lowering the loading frequencies to about 1 c/min steadily increased the crack growth rate da/dN, but below this frequency, cracks tended to incubate, reducing the average crack growth rate under the loading conditions employed in this study. Accordingly, the fatigue life of the specimens was prolonged by an amount corresponding to the sum of the incubation periods. The concentration of oxygen dissolved in water has a strong influence on the incubation time of crack growth under slow testing conditions. A slight increase in dissolved oxygen above the level typical of a BWR causes a substantial increase of the fatigue life. The role of pitting corrosion near the tips of the cracks is suspected to be one of interrupting the continuous growth of the cracks. Fractographic observation and the effect of oxygen addition to water gave supporting evidence to this hypothesis. An extensive discussion is included. (28 figures) (auth)

6216 CORROSION FATIGUE IN LIQUID METALS. Horton, K. E. (Atomic Energy Commission, Washington, DC). pp 601-605 of Corrosion Fatigue: Chemistry, Mechanics, and Microstructure. Devereux, O. F. (ed.). Houston, TX; National Association of Corrosion Engineers (1972).

From international conference on corrosion fatigue: chemistry, mechanics and microstructure; Storrs, Connecticut, USA (14 Jun 1971). See CONF-710603-.

Data from tests in the early 1960's are summarized, and the current status of recent tests is given. The tendency for corrosion fatigue in sodium is shown to exist under conditions where there is a change in composition of the test specimens, and in particular, when carbon is moving. Conversely, fatigue tests in isothermal sodium wherein there is no specimen composition change yield results superior to air tests. The recent fatigue programs, like those of a few years back, again proved that test results vary enormously with test method and specimen design. Contrary to the original purpose of initiating these basic test programs, the results strongly suggest that fatigue tests should be run on actual component mockups under conditions duplicating those expected in reactor plants. This conclusion is held both for design data and material screening tests. Since there are still a substantial number of untested material conditions induced by sodium corrosion that could affect fatigue life of reactor components (e.g., decarburized fuel element cladding), continued emphasis will be placed on this potential problem. Clearly, past results dictate that the experimentor works closely with the designer in order to simulate, as much as possible, the operating stresses or strains and the planned environment. Finally, the success of constant-strain-rate test method in permitting data extrapolation encourages the use of this technique in attacking the combined sodium mass transfer–neutron fluence fatigue problem. (16 references) (auth)

6217 REVIEW OF NASA RESEARCH TO DETERMINE RESISTANCE OF MATERIALS TO CAVITATION DAMAGE IN LIQUID–METAL ENVIRONMENTS. Young, S. G.; Freche, J. C. (Lewis Research Center, Cleveland). pp 646-664 of Corrosion Fatigue: Chemistry, Mechanics, and Microstructure. Devereux, O. F. (ed.). Houston, TX; National Association of Corrosion Engineers (1972).

From international conference on corrosion fatigue: chemistry, mechanics and microstructure; Storrs, Connecticut, USA (14 Jun 1971). See CONF-710603-.

Resistance to cavitation damage in sodium at 427°C and mercury at 149°C was studied for the following materials: Stellite 6B, René 41, L-605, Hastelloy X, A-286, Inconel 600, AISI 318 and 316 stainless steels, and Sicromo 9M. The cavitation resistance ranking of materials was the same in both liquid metals, with the damage in 149°C Hg being greater than in 427°C Na. Stellite 6B was far superior to the others. Increasing pressure increased the cavitation damage, with no change in the relative ranking of the materials. Results of metallographic examinations are given; the ultrasonic vibratory method of accelerating the cavitation was found to be useful. (23 figures, 40 references) (DLC)

6218 STUDY BY NUCLEAR MICROANALYSIS AND ^{18}O TRACER TECHNIQUES OF OXYGEN TRANSPORT PROCESSES AND GROWTH LAWS FOR POROUS ANODIC OXIDE LAYERS ON ALUMINUM. Cherki, C.; Siejka, J. (Ecole Normale Superieure, Paris). J. Electrochem. Soc.; 120: No. 6, 784-791(Jun 1973).

The method of nuclear microanalysis of stable oxygen isotopes by the reactions ^{16}O (d,p) $*^{17}$O and ^{18}O (p,α) ^{15}N was used to investigate the mechanisms of growth, dissolution, and transport associated with oxygen during the formation of relatively thin ($\leq$7000 Å) porous anodic layers on aluminum. The average charge associated with an oxygen ion fixed in the film was calculated on the basis of the direct measurement of sulfur incorporation in the films. The current efficiency of the oxidation was determined (and found to be low, ~55%) by comparing the amount of oxygen fixed on the metal surface deduced from nuclear microanalysis to that deduced from the amount of charge fed into the circuit. The rate of chemical dissolution of the oxide was measured in open circuit and under polarization and was found to be two orders of magnitude lower than that which would explain the low current efficiency. Hence the existence of an electrochemical process of cation transfer must be assumed. It was found, by using oxygen-18 tracer techniques, that the growing oxide layer is formed at the metal/oxide interface by oxygen transport through the base layer. The results show that about 60% of the ionic current is transported by oxygen ions and about 40% by cations during the growth of porous oxide layers on aluminum. (29 references) (auth)

6219 KINETICS OF THIN-OXIDE-FILM FORMATION ON IRON USING PROTON-IMPACT-EXCITED X-RAY ANALYSIS. Needham, P. B. Jr.; Leavenworth, H. W. Jr.; Driscoll, T. J. (Dept. of Interior, College Park, MD). J. Electrochem. Soc.; 120: No. 6, 778-783(Jun 1973).

Studies of the oxidation of high-purity iron samples at 224, 285, and 350°C were conducted in an oxygen partial pressure of 4×10^{-6} torr for exposure times ranging from 25 to 2000 s. The oxide films were measured and quantitatively analyzed for trace carbon impurities using proton-impact-excited characteristic x rays. Analytical surface sensitivities to the equivalent of 10^{-3} monatomic layers have allowed direct studies of ultrathin (< 50 Å) oxide film kinetics. A two-stage logarithmic oxidation rate law was observed at all temperatures with the transition from the first to second stage occurring at oxide thicknesses of 25, 36, and 52 Å at 224, 285, and 350°C, respectively. This observation is discussed in terms of Uhlig's theory for logarithmic oxidation. Quantitative measurements of carbon impurities on the iron surfaces show that an increase in the preoxidation surface coverage from 0.1 to 1.0 monolayer results in a significant suppression of the oxidation process. Detailed studies were made of the removal of residual carbon and oxygen impurities and 12–14 Å air-formed oxide films from the iron surface by vacuum annealing at 715°C. Without H_2 reduction techniques, preoxidation iron surface coverages of 0.4 monolayer oxygen and one monolayer carbon were routinely obtained. Also, the residual surface carbon, present prior to oxidation, does not oxidize off of the surface during the oxidation process at these temperatures. (30 references) (auth)

6220 OXIDATION PROTECTION OF TANTALUM AND TANTALUM ALLOYS AT 1500°C. Fitzer, E.; Schlichting, J. (Univ., Karlsruhe, Ger.). Planseeber. Pulvermet.; 20: No. 2, 110-128 (Jun 1972). (In German).

Systematic diffusion and sintering studies carried out over several years have demonstrated the possibility of developing an effective oxidation protection for tantalum and its alloys. This development is based on the excellent oxidation resistance of $MoSi_2$; the slow diffusion of the silicon into the tantalum core, due to the lower mobility of silicon in Ta_5Si_3 layers; the very similar thermal expansion coefficients of $MoSi_2$ and metallic tantalum, and a suitable coating method which enables $MoSi_2$ to be applied to tantalum surfaces without pore formation. Thus, $MoSi_2$-coated tantalum can withstand corrosion in air at 1550°C for up to 1000 hours. For cyclical temperature conditions, a modification of the glass layer through addition of GeO_2 is necessary. Test results have confirmed the theoretically calculated corrosion resistance of these coatings. (auth)

Preparation and Fabrication

Refer also to abstracts 5387 and 6191.

6221 (CONF-730402-(P1-2), pp 63-71) PRECISION INVESTMENT CASTING OF MISCH METAL ALLOYS. Chandley, G. D. (Hitchiner Manufacturing Co., Inc., Milford, NH). 1973.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

A high-volume production capability was developed for misch metal alloy components (3.5 to 6.5% Mg). Some of the techniques required due to the extreme reactivity of the metal are described: wax assemblies, mold making, melting and pouring, and finishing. (DLC)

6222 (CONF-730402—(P1-2), pp 682-691) ELECTROWINNING YTTRIUM–ALUMINUM ALLOY FROM YTTRIA–ALUMINA MIXTURES. Morrice, E.; Whisler, N.; Wong, M. M. (Bureau of Mines, Reno, NV). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Research demonstrated that yttrium–aluminum alloy of approximate eutectic composition (91 wt % Y) can be electrowon from mixtures of yttria and alumina dissolved in a YF_3–LiF melt by using a cell design incorporating a liquid Y–Al alloy cathode and a graphite anode. Satisfactory operation of the cell depends primarily on two factors: (1) The choice of a YF_3–LiF electrolyte of sufficiently low LiF content to minimize loss of yttrium metal through chemical reaction, and (2) a cell feed with the necessary Y_2O_3/Al_2O_3 ratio for preparing a Y–Al alloy composition that will insure the maintenance of the liquid cathode pool at the bottom of the cell. (2 tables, 4 figures, 11 references) (auth)

6223 (CONF-730402-(P1-2), pp 692-700) COBALT–RARE EARTH POWDERS BY THE REDUCTION–DIFFUSION PROCESS. McFarland, C. M. (General Electric Co., Schenectady, NY). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

The R–D process will produce a Co_5R powder of desired chemical composition using a variety of sources of rare earth oxides. It offers a potentially low cost path to CoR magnets. Results are given for R = Sm, Sm–Pr, and Sm–Pr–Misch metal. (DLC)

6224 (DUN-8097) MANUFACTURING PROCESS TECHNIQUES FOR ON-SITE COMPONENT FABRICATION. (Douglas United Nuclear, Inc., Richland, Wash.). 4 Dec 1972. 38p. Dep. NTIS $4.00.

Techniques for fabrication of components used in U fuel element extrusion are described. Techniques are included on Cu–Si preshape fabrication, and Zircaloy-2 clad shell and end cap stock fabrication. (JRD)

6225 SYNTHESIS OF SINGLE-PHASE ZIRCONIUM DIBORIDE FROM THE ELEMENTS. Serbezova, R. Ya.; Ordan'yan, S. S.; Avgustinnik, A. I. (Leningrad Technological Inst.). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 16: No. 4, 499-503(1973). (In Russian).

The production of pure ZrB_2 from the elements in a vacuum was investigated. It was concluded that the final heating temperature necessary was 1973°K, maintaining this for one hour at 10^{-4} mm Hg pressure. The lattice constant of the resulting ZrB_2 varied from 3.1688 to 3.1684, as the boron content varied from 65.20 to 68.20 at. %. The lattice constant c was practically invariant. (KSW)

6226 ELECTRODEPOSITION OF NICKEL–MOLYBDENUM PLATING FROM A PYROPHOSPHATE ELECTROLYTE. Stasov, A. A.; Pasechnik, S. Ya. (Voronezh Technological Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 16: No. 4, 600-603(1973). (In Russian).

An alloy of Ni–Mo with from 0.5 to 35% Mo could be deposited from a solution of 160 g/l Na pyrophosphate, containing $NiSO_4$, NH_4Cl, and $NaMoO_4$, at a pH of 8 to 8.5, a temperature of 20 to 40°C, and a current density at the cathode of 0.5 to 5 A/dm^2. The current density controlled the degree of luster of the alloy coating. (KSW)

6227 PRODUCTION OF AN ENAMEL-LIKE PHASE OF ANODIC TANTALUM OXIDE. Bogoyavlenskii, A. F.; Matyazh, N. K. (Kazan Aviation Inst.). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 16: No. 4, 649-650(1973). (In Russian).

The optimum conditions were found experimentally for obtaining an enamel-like tantalum oxide, employing an electrolyte composed of 20% H_2SO_4 and 35% H_2F_2 in a ratio of 10 : 1 by volume and a current density of one A/dm^2. The anode process was continued for 60 min at 20°C. An anode layer of tantalum oxide 40 u or more may be formed under these conditions. (KSW)

6228 HIGH-TEMPERATURE COMBUSTION CALORIMETRY. 1. Enthalpies of Formation of Tungsten Oxides. Charlu, T. V.; Kleppa, O. J. (Univ. of Chicago). J. Chem. Thermodyn.; 5: No. 3, 325-330(May 1973).

The enthalpies of formation of the tungsten oxides WO_2, $WO_{2.72}$, and $WO_{2.90}$ have been determined by oxidation to WO_3 in a high-temperature microcalorimeter. After correction, the standard enthalpies of formation at 298.15 K are $-(140.19 \pm 0.70)$, $-(186.34 \pm 0.27)$, and $-(195.08 \pm 0.22)$ kcal$_{th}$ mol^{-1}, respectively. (auth)

6229 FOILS AND FILMS OF RARE-EARTH METALS. Lishenko, L. G.; Nazarova, T. S.; Rozen, A. A. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1262-1263(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 243-244(1972).

Methods are considered for synthesizing trivalent iodides of rare-earth metals (r.e.m.) from the point of view of the possibility of obtaining films and foils of these metals for nuclear investigations by means of thermal decomposition of the iodide. Experimental data are presented on the decomposition of tri-iodides with vacuum deposition of metal films on a substrate. The possibility of obtaining r.e.m. films having a low vapor pressure (Sm, Gd, Tb, Lu, Er) is demonstrated. (auth)

6230 PURGING PRACTICES FOR NUCLEAR PIPE WELDING. Holby, E. (Pioneer Service and Engineering Co., Chicago). Weld. Eng.; 58: No. 1, 20-3(Jan 1973).

Advanced methods of welding steel pipe are discussed emphasizing automatic or manual tungsten inert gas (TIG) welding using consumable inserts and inert gas backing. Information is included on weld root purging by inert gas, soluble dams in weldings, total system purging, oxygen control, and contamination control. (JRD)

6231 POSSIBILITY OF PURIFYING Ce BY ZONE MELTING. Revel, G.; Pastol, J. L.; Rouchaud, J. C.; Michel, A. (CNRS, Vitry-sur-Seine, France). Compt. Rend., Ser. C; 276: No. 2, 153-155(8 Jan 1973). (In French).

The experimental conditions under which zone melting can be efficiently used for the purification of Ce were studied. The elimination of impurities during the tests was controlled by an activation-analysis method. The results demonstrate that it is possible to diminish the iron concentration down to 0.07×10^{-6}. (FR)

6232 ASPECTS OF AVAILABILITY AND SAFETY OF WELDED COMPONENTS WITH GREATER WALL THICKNESS FOR POWER GENERATING PLANTS. Kussmaul, K. (Staatliche Materialpruefungsanstalt, Stuttgart). Maschinenschaden; 45: No. 6, 231-242(1972). (In German).

The quality of welded components depends on various parameters of which the toughness of the base metal, weldability and reliability of the welded parts, failure probability, choice of materials and given permissible stresses, special features of the design, and residual welding stresses are the most important. It is sometimes difficult to make a clear cut between reduced availability and diminished safety of a welded component, as this very often depends on the degree of embrittlement, and the availability of a component has to be assessed in the light of possible repairs. High-pressure vessels and high-pressure tubes made of low- and high-alloyed steels are discussed as examples with reference to two different temperatures, namely <400°C (high temperature yield point) and >400°C (creep strength depending on time). (GF)

6233 WELDING AUSTENITIC STEELS IN THE CONSTRUCTION OF LARGE NUCLEAR REACTORS. Schabereiter, H.; Folkhard, E.; Ablasser, F.; Ornig, H.; Neff, F. Berg–Huettenmaenn. Monatsh.; 117: No. 5, 167–181(May 1972). (In German).

The corrosion resistance requirements of water-cooled nuclear reactor materials are discussed and the use of austenitic steels as filler metal for nuclear-reactor construction is outlined. The resistance to inter-crystalline corrosion of, e.g., 19/10 Cr–Ni steel, grade X4 CrNi 19 10, is illustrated, and the effects of the addition of Nb and precipitation of $M_{23}C_6$, on the corrosion mechanism explained. The properties of austenitic steels such as 19/10 Cr−Ni used as filler metal can also be modified to prevent embrittlement. For welding cladding by the submerged-arc strip (electrode) welding technique, Type 22 NiMoCr 37 alloy is used as the parent metal and CN 21/1 Nb for the strip. (Metals Abstr.)

6234 FUSED-SALTS DIFFUSION-COATING TECHNIQUES. Withers, J. C.; Perry, J. E.; Fosnocht, B. A. (General Technologies Corp., Reston, VA). pp 203-227 of Techniques Involving Extreme Environment, Nondestructive Techniques, Computer Methods in Metals Research, and Data Analysis. Bunshah, R. F. (ed.). New York; John Wiley and Sons, Inc. (1972).

Metal diffusion from fused salts into metal surfaces with subsequent alloying is discussed. Fundamentals and techniques are described. Applications are described: berylliding, boriding, siliciding, aluminiding, titaniding, chromiding, etc. (14 figures, 20 references) (DLC)

6235 TECHNOLOGY OF PLASMA ARC SPRAYING. Hecht, N. L. (Univ. of Dayton, OH). pp 229-278 of Techniques Involving Extreme Environment, Nondestructive Techniques, Computer Methods in Metals Research, and Data Analysis. Bunshah, R. F. (ed.). New York; John Wiley and Sons, Inc. (1972).

A review is presented of the application of the plasma arc and associated flame spraying equipment for material processing, particularly coating deposition and spray forming. Other competitive spraying techniques are also considered. (28 figures, 4 tables, 61 references) (DLC)

6236 TECHNIQUES FOR FABRICATION OF COMPOSITE MATERIALS. Grierson, R.; Krock, R. H. (P. R. Mallory and Co., Burlington, MA). pp 279-340 of Techniques Involving Extreme Environment, Nondestructive Techniques, Computer Methods in Metals Research, and Data Analysis. Bunshah, R. F. (ed.). New York; John Wiley and Sons, Inc. (1972).

Emphasis in this review is on fabrication techniques rather than the composites produced. Techniques for dispersion-strengthened alloys, particulate composites, fibrous composites, and laminates are described. Sources for further information are given. (28 figures, 5 tables, 67 references) (DLC)

6237 VACUUM DISTILLATION OF DYSPROSIUM. Pavlov, V. S.; Ivantsov, I. I.; Saenko, E. M.; Reshetova, L. N. Izv. Akad. Nauk SSSR, Metal.; No. 6, 99-104(1972). (In Russian).

The distillation of Dy was investigated at various volatilization rates and condensation at various temperature gradients. The purest metal condensed at 900 to 1000°C, yielding 99.98% pure Dy. A double distillation raised the purity of the metal, as did distillation through a tungsten filter. The relative electrical resistance of Dy was increased to 100 by passage of Dy vapors through a W filter. (tr-auth)

6238 PRODUCTION OF HIGH-DENSITY REFRACTORY METALS. Ivanov, V. E.; Nechiporenko, E. P.; Krivoruchko, V. M.; Sagalovich, V. V.; Khrebtov, V. L.; Mitrofanov, A. S.; Derizemlya, I. A. Izv. Akad. Nauk SSSR, Metal.; No. 4, 129-135(1972). (In Russian).

The dependence of metal density, obtained by precipitation from the gaseous phase, was studied as functions of several parameters of the condensation process. Layers of Mo, W, and Nb were formed on supports of Cu, Ni, and W(Nb) from the corresponding gaseous phases: $MoCl_5$, $Mo(CO)_6$, WF_6, $W(CO)_6$, and $NbCl_5$. Studies of the influence of temperature reached as high as 1200°C with some of the compounds. A correlation between metal density and rate of precipitation was established, and mechanisms of the process were discussed. (KSW)

6239 PRODUCTION OF INDIUM BY HEATING IN A VACUUM. Aleksandrov, B. N.; Udovikov, V. I.; Usenko, L. E. Izv. Akad. Nauk SSSR, Metal.; No. 4, 123-128(1972). (In Russian).

The behavior of 38 impurity elements during the heating of In to ~1050°C in a high vacuum was studied. Tests showed that Cd, Zn, K, Te, Tl, Na, Li, Bi, and Pb volatilized from the alloy, but the following remained: As, Sb, Sc, Co, Sn, Ni, Co, Si, Au, Ge, Y, Ho, Cr, Fe, Pd, Ti, V, Pt, Rh, Ru, and the majority of Ag and Ba. The following distribute themselves uniformly between the residue and the condensate: Al, Be, Ga, Mn, Sr, Mg, and Ca. Vacuum treatment at ~1050°C of a technical grade of In yielded >99.98% pure In. (KSW)

6240 FABRICATION OF REACTOR COMPONENTS. de Comtes, H.; Wallner, F.; Mayrhofer, M.; Furthner, A. Berg-Huettenmaenn. Monatsh.; 117: No. 5, 190-198(May 1972). (In German).

The main components of a typical, water-cooled nuclear reactor are the pressure vessel, e.g., of 22 NiMoCr 37 clad material; core housing, e.g., of X6 CrNiNb 18 8; pressure units, e.g., of clad 15 MnMoNiV 53 (NiMoV); heat exchanger tubes of 22 NiMoCr 37 or Incoloy and a fine-grained structural steel containment. The fabrication of these components is described. Particular attention is paid to the welding problems and stress-relieving operations. (Metals Abstr.)

6241 SPECIFICATION FOR HIGH TEST WROUGHT WELDING FITTINGS. SP-75-1973. Arlington, VA; Manufacturers Standardization Society of the Valve and Fitting Industry (1973). 27p.

A standard prescribing specification for high-test wrought welding fittings for nuclear and associated applications is presented. (JRD)

6242 ELECTRODEPOSITION OF COHERENT BORON. Kellner, J. D. (United Aircraft Research Labs., East Hartford, CT). J. Electrochem. Soc.; 120: No. 6, 713-716(Jun 1973).

Pure coherent boron was electrodeposited from a fused fluoride mixture. A eutectic mixture of LiF and KF is used as the electrolyte, with BF_3 gas dissolved to form the tetrafluoborate ion which reacts at the cathode to produce boron. The boron as plated is of 95% or better purity, and is homogeneous and uncracked, up to 25 mils thickness. The substrates plated include steel, copper, graphite, tungsten, and molybdenum. Temperatures of plating range from 600 to 700°C, with plating rates up to 6 mils/h. (auth)

6243 SOLID REACTIONS IN POWDER-METALLURGICAL PRODUCTION OF Mo ALLOY TZM. Eck, R. (Metallwerk Plansee, Reutte/Tyrol, Austria). Planseeber. Pulvermet.; 20: No. 2, 95-109(Jun 1972). (In German).

The production of sintered compacts of the molybdenum alloy TZM containing 0.5% Ti, 0.07% Zr and 0.01 to 0.05% C is described, with special emphasis on the sintering process. The reactions between the oxygen contained in the powder and the moisture in the sintering atmosphere with the alloying elements are discussed. The carbon has a deoxidizing as well as a carbide forming effect. The carbides and oxides produced during sintering are described on the basis of optical and scanning electron micrographs. Sintered TZM can be worked even at high oxygen contents, whereas pure molybdenum is no longer ductile at even lower oxygen concentrations. TZM, owing to the low titanium and carbon content, does not age harden. The hot shortness of fused and sintered TZM at temperatures of 1300 to 1650°C coincides with the increased deformation resistance in forging and extrusion of sintered molybdenum. Examples for the annealing and recrystallization behavior of TZM sheet in comparison with that of pure molybdenum are given. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 5858, 5859, 5864, 5865, 6905, 6906, and 7341.

6244 (AD-754959) TECHNOLOGY DEPARTMENT FOR TRANSITION METAL−RARE EARTH HIGH-PERFORMANCE MAGNETIC MATERIALS. Semiannual Interim Technical Report No. 4, 1 January−30 June 1972. Becker, J. J. (General Electric Co., Schenectady, N. Y.). Sep 1972. Contract F33615-70-C-1626. 53p. (SRD-72-126; AFML TR-72-187). NTIS.

A session that has been organized for the 1972 Magnetism Conference will review work done under this contract and elsewhere on the problem of the origin of the coercive force in high-anisotropy materials. Polarized light metallography has been used to study magnetic domain configurations in Co_5Sm, Co_5Y, Co_5Ce, and Co_5Pr as a function of crystal thickness. Magnetic domain structures in several $Co_{17}R_2$, $(Co,Fe)_{17}R_2$, and Co_7R_2 phases examined using polarized light. The magnetic moment and hysteresis properties of a high-density, nearly completely oriented Co_5Sm magnet alloy have been measured from 300 to 4.2°K and in applied fields up to 140 kOe. The demagnetization properties of a series of sintered Co−Sm magnets have been measured over the range 0 to 750°K. Saturation magnetization, intrinsic coercive force, anisotropy field, and anisotropy constants were determined for a sample of sintered Co_5Sm at 4.2, 77, 300, and 500°K. The relationship between the temperature dependence of the coercivity and the anisotropy parameters is discussed. (NTIS)

6245 (CONF-730402−(P1-2), pp 87-95) MAGNETIC PROPERTIES OF RCo_2Ge_2 COMPOUNDS (R = La, Ce, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, and Y). McCall, W. M.; Narasimhan, K. S. V. L.; Butera, R. A. (Univ. of Pittsburgh). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30−May 3, 1973.

The compounds for which R = La, Ce, Sm, Er, Tm, Yb, and Y exhibit paramagnetic behavior down to 4.2°K with $ErCo_2Ge_2$ and $TmCo_2Ge_2$ probably ordering at lower temperatures. The compounds for which R = Gd, Tb, Dy, and Ho, order antiferromagnetically. $PrCo_2Ge_2$ and $NdCo_2Ge_2$ show an unusual magnetic behavior. $PrCo_2Ge_2$ exhibits a susceptibility which decreases from 4.2°K, then rises to a peak at 27.5°K. $NdCo_2Ge_2$ has two peaks in the susceptibility versus temperature curve at 13.5 and 27.5°K. The Néel points for the heavy rare-earth compounds follow the de Gennes function, and the equation $\chi_M = \chi_0, M + C_M/T - \theta$ is used to interpret the susceptabilities in the paramagnetic region. χ_M is the molar susceptibility; χ_0, M, a temperature-independent contribution to the susceptibility; C_M, the Curie constant; T the temperature; and θ the Weiss constant. (auth)

6246 (CONF-730402–(P1-2), pp 96-104) MAGNETISM OF THE RARE-EARTH INTERMETALLIC COMPOUNDS. Burzo, E. (Inst. for Atomic Physics, Bucharest). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

The following aspects of magnetism of ferrimagnetic and ferromagnetic compounds AB (A = rare earth, B = a 3d transition metal) are discussed: (1) to what extent Neel's theory may describe the magnetic behavior of ferrimagnetic compounds, (2) the application of the molecular field model to the magnetic properties of cubic ferromagnetic compounds, and (3) the magnetic behavior of Fe, Co, and Ni. The following compounds are considered in detail: $GdCo_2$, $GdCo_3$, $ErFe_2$, YFe_2, and $GdNi_2$. (12 references, 4 figures) (DLC)

6247 (CONF-730402–(P1-2), pp 105-110) PROPERTIES OF PERMANENT MAGNETS MADE FROM REDUCTION–DIFFUSION COBALT–RARE EARTH POWDERS. Martin, D. L.; Laforce, R. P.; Rockwood, A. C.; McFarland, C. M.; Valentine, L. (General Electric Co., Schenectady, NY). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Co–R alloys (R = rare earth) may be produced at a lower cost by the reduction–diffusion (R–D) process: $R_2O_3 + 3\ Ca + 10\ Co \rightarrow ZCo_5R + CaO$. Permanent-magnet properties were studied for magnetics made from R–D base powders of Co–Sm, Co–Sm–Pr, and Co–Sm–misch metal–Pr. A comparison is made of the use of R–D vs reduction–melting base powders. (15 references) (DLC)

6248 (CONF-730402–(P1-2), pp 218-227) ROLE OF ELECTRONEGATIVITY IN CRYSTAL FIELD SPLITTINGS OF RARE-EARTH COMPOUNDS. Bucher, E.; Maita, J. P. (Bell Labs., Murray Hill, NJ). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Empirical rules are developed for crystal field splittings in rare earth compounds (mostly intermetallic) in order to make predictions from atomistic parameters of the individual ligands. Compounds discussed include PrX, PrX_3, and other Pr^{3+} (pnictides and chalcogenides) and U^{4+} compounds. It is concluded that elements with low electronegativities will in general exhibit positive ligand charges and strongly electronegative elements negative ligand charges, with sign reversal occurring at $\epsilon \sim 1.7$. (1 table, 4 figures, 12 references) (DLC)

6249 (CONF-730402–(P1-2), pp 228-234) CALCULATION OF ELECTRONIC STRUCTURE OF SOME CUBIC INTERMETALLIC COMPOUNDS OF YTTRIUM AND DYSPROSIUM. Belakhovsky, M. (CEN, Grenoble, France); Pierre, J.; Ray, D. K. 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

APW calculations of the wave functions of the conduction electrons were carried out for YZn, DyZn, DyCu, and DyRh. Tentative cross sections of the Fermi surface of YZn and YCu are given. The band structure and density of states are shown in graphs for DyRh. (DLC)

6250 (CONF-730402–(P1-2), pp 235-244) ENERGY-BAND CALCULATIONS FOR CUBIC LAVES COMPOUNDS $LaAl_2$, $LuAl_2$, AND YAl_2. Switendick, A. C. (Sandia Labs., Albuquerque, NM). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

The nonrelativistic augmented plane-wave energy band method is used to perform calculations for YAl_2, $LaAl_2$ (f^0), $LaAl_2$ (f^1), and $LuAl_2$. Density of states at the Fermi energy and the component density of states derived from the four calculations are given in detail. Values of contact Knight shift are derived at each of the nuclei and compared with experimental values. Energy bands and densities of states are plotted for $LaAl_2$ (f^1). Orbital hyperfine field associated with the f character in the conduction band is also calculated. It is concluded that there is considerable f-electron character mixed into the conduction bands near the Fermi energy in $LaAl_2$. (2 tables, 2 figures, 31 references) (DLC)

6251 (CONF-730402–(P1-2), pp 245-253) ATOMIC CONTRACTIONS AND RESONANT BONDS IN SOME RARE EARTH–TRANSITION METAL ALLOY PHASES. Raman, A. (Louisiana State Univ., Baton Rouge). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

This paper analyzes the near-neighbor contact distances in some of the commonly encountered crystal structures and interprets the contractions or expansions in the bond lengths. The crystal structures considered are $MgCu_2$-type Laves LnX_2 phases, $CaZn_5$-type LnX_5, Fe_3C-type Ln_3X, Mn_5Si_3-type Ln_5X_3, Cu_3Au-type LnX_3 and Ln_3X, and CsCl-type LnX. It is concluded that, in phases containing small amounts of rare earths, the latter have a tendency to contract in the Ln–T phases, (T = transition metal) whereas they appear to expand in some B-metal-rich (Mg and Al) phases (B = a nontransition element). (17 references) (DLC)

6252 (CONF-730402–(P1-2), pp 254-262) EFFECT OF GRAIN SIZE ON ELECTRONIC DISTRIBUTION IN VERY THIN FILMS OF YTTERBIUM. Bonnelle, C.; Vergand, F.; Karnatak, R. C. (Univ., Paris). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Thin Yb films 30 to 300 Å thick were deposited and the interatomic distance vs grain and size relation determined. A discontinuity is seen at 30 Å between Yb II (bulk metal) and Yb (III) (trivalent). X-ray M(IV)–M(V) emission spectra of Yb II, Yb III, and Yb_2O_3 were obtained and are analyzed. The spectra of samples with grain size <30 Å are characteristic of a metal with thirteen 4f electrons and three conduction electrons per atom, suggesting that the valence changes as the grain size falls. (DLC)

6253 (CONF-730402–(P1-2), pp 263-271) HEAT-CAPACITY STUDIES ON $DyFe_{3-x}Ni_x$ COMPOUNDS. Narasimhan, K. S. V. L.; Cato, R. J.; Butera, R. A. (Univ. of Pittsburgh). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Low-temperature heat capacity measurements were made on $DyFe_{3-x}Ni_x$ compounds (x = 0, 1, 1.5, 2, 3:). The electronic specific heat coefficient was found to have a maximum at x = 1. Large excess heat capacity was measured for $DyNi_3$ and is attributed to be due to a Schottky type of anomaly. The γ variation as a function of x was discussed in terms of a band model for the 3d transition metals. (auth)

6254 (CONF-730402–(P1-2), pp 272-281) HEAT-CAPACITY BEHAVIOR OF $DyNi_5$, $HoNi_5$, AND $ErNi_5$ BETWEEN 4 AND 300°K. Sankar, S. G.; Keller, D. A.; Craig, R. S.; Wallace, W. E.; Rao, V. U. S. (Univ. of Pittsburgh). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

These C_p measurements were used to extract the magnetic entropy and to calculate the thermodynamic functions. Magnetic contributions to C_p are plotted at 2 to 70°K. Eigenvalues of the crystal-field states are plotted as a function of Y for $ErNi_5$ in the ordered region. The magnetic susceptibility of $ErNi_5$ in the paramagnetic region was calculated and found to agree with experiment. (7 figures) (DLC)

6255 (CONF-730402–(P1-2), pp 282-291) MAGNETIC PROPERTIES OF $R_{2-x}R_x^1Co_{17}$ COMPOUNDS (R = Gd, Dy, Ho or Er; R^1 = Th or Ce). Narasimhan, K. S. V. L.; Wallace, W. E. (Univ. of Pittsburgh). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

A study was made of the effects of Th and Ce substitutions on the magnetic ordering of R_2Co_{17} compounds. Replacement of Th for Dy, Ho, or Er stabilized the Th_2Zn_{17}-type structure, whereas Ce substitution left the structure unaltered. It is concluded that Ce has a radius close to 1.773 Å and has a valence much less than four. Plots of molecular moment, cobalt moment, and magnetization in the 0 to 300°K range are given. The easy direction of magnetization in all the Gd, Dy, and Ho compounds remains unchanged in the basal plane, whereas in $Er_{2-x}Th_xCo_{17}$, the direction changes over from the C axis to the basal plane beyond x = 0.2. (DLC)

6256 (CONF-730402–(P1-2), pp 292-300) STRUCTURAL AND MAGNETIC PROPERTIES OF SOME $R_{1-x}Th_xFe_3$ (R = Sc, Y, Pr, Ce, Dy, Lu) INTERMETALLIC COMPOUNDS. Kunesh, C. J.; Narasimhan, K. S. V. L.; Butera, R. A. (Univ. of Pittsburgh). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Measurements of magnetization vs temperature (0 to 700°K) and field (0 to 20 kOe) were made. Results are discussed relative to a model developed for the anomalous magnetic behavior and based on the Friedel d-band model for transition metals. (8 figures, 10 references) (DLC)

6257 (CONF-730402–(P1-2), pp 301-310) PSEUDOBINARY ALLOYS OF RARE-EARTH METALS WITH 3d METALS. Hilscher, G.; Kirchmayr, H.; Steiner, W.; Wiesinger, G. (Technische Hochschule, Vienna). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Investigations of the ternary systems $R_a(M^1_xM^2_{1-x})_b$, where M^1 and M^2 = Mn, Fe, Co, and/or Ni are discussed. Structure, stability of the phases, and magnetic properties were studied. The following alloys are discussed: $R(Mn,Fe)_2$, $R_6(Mn,Fe)_{23}$, $R(Fe,Co)_2$, $R_2(Fe,Co)_{17}$, $R_6(Fe,Ni)_{23}$, $R(Fe,Ni)_5$, and $R_2(Fe,Ni)_{17}$. Results show that a simple interpretation of phase stability, structure, and magnetic properties is not possible. (17 references, 6 figures) (DLC)

6258 (CONF-730402–(P1-2), pp 429-438) MAGNETIC PROPERTIES OF $Gd_{1-x}Th_xFe_2$ AND $Gd_{1-x}Ce_xFe_2$. Miskinis, E. T.; Narasimham, K. S. V. L.; Wallace, W. E.; Craig, R. S. (Univ. of Pittsburgh). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Magnetic and x-ray investigations are reported on the effects of Ce and Th substitution for Gd in $GdFe_2$. Curie temperatures, saturation moments, and lattice parameters are tabulated, and plots of magnetization, moment, and lattice parameter temperature (0 to 800°K), composition, and field (0 to 20 kOe) are presented. Results show that increasing the electron concentration does not change the magnetic coupling between the rare earth and iron. The observed variation of the iron moment can be explained on the basis of known models for transition metals. (DLC)

6259 (CONF-730402 –(P1-2), pp 439-448) DIPOLAR CONTRIBUTIONS TO MAGNETIC HYPERFINE FIELDS IN $Er_xY_{1-x}Fe_2$ AND $Tb_xY_{1-x}Fe_2$ COMPOUNDS. Dariel, M. P. (Nuclear Research Centre, Beersheba, Israel); Atzomony, U.; Lebenbaum, D. 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Moessbauer effect measurements on ^{57}Fe were carried out in the pseudo-binary systems $Er_xY_{1-x}Fe_2$ and $Tb_xY_{1-x}Fe_2$, at 4.2, 80, and 300°K. The isotropic part of the hyperfine field, acting on the iron nuclei, is not independent of the rare-earth ions. Magnetic dipolar contributions account only in part for the differences in the magnitude of the hyperfine fields at the inequivalent sites. (auth)

6260 (CONF-730402–(P1-2), pp 449-457) MAGNETOSTRICTIVE PROPERTIES OF $Ho_xTb_{1-x}Fe_2$ INTERMETALLIC COMPOUNDS. Koon, N. C.; Schindler, A. I.; Carter, F. L. (Naval Research Lab., Washington, DC). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

The magnetostriction of several compounds in the series $Ho_xTb_{1-x}Fe_2$ was measured from 77 to 300°K using magnetic fields up to 17.5 kOe. The saturation magnetostriction at room temperature obtained by extrapolation of the high-field data varies linearly with x between the limits of 1720 × 10^{-6} for $TbFe_2$ and 80 × 10^{-6} for $HoFe_2$. This suggests that the single ion model of magnetostriction is valid for these compounds and that the local magnetization of the Tb and Ho atoms is independent of x. This latter conclusion is to be expected if the exchange field on the rare earth sites is dominated by rare earth–iron exchange. Near the composition x = 0.85, the magnetostriction saturates at much lower values of the applied field than for other values of x, which suggests that near this composition the magnetocrystalline anisotropy is greatly reduced. This result is in good agreement with the recent Moessbauer work of Atzmony, et al., which shows a "triple point" in the spin rotation diagram near that composition. (auth)

6261 (CONF-730402–P1-2), pp 458-465) MAGNETIZATION AND MAGNETOSTRICTION IN Y_2Co_{17} AND Dy_2Co_{17}. D'Silva, T.; Igarashi, H.; Miller, A. E. (Univ. of Notre Dame, IN). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Large single crystals of Y_2Co_{17} and Dy_2Co_{17} were grown, and discs were cut normal to the hexagonal c axis and normal to the b axis for the direct determination of two of the degree two magnetostriction coefficients (λ^γ and λ^ϵ) by standard strain gage techniques. Magnetization at 78 to 298°K was also measured along specific directions. Saturation moments of 125.5 and 68.9 emu/g were derived for Y_2Co_{17} and Dy_2Co_{17}. Room-temperature anisotropy values of 3.85 × 10^6 and 2.10 × 10^7 ergs/cc were found for $K_1 + K_2$ in Y_2Co_{17} and Dy_2Co_{17}. It is concluded that in Dy_2Co_{17} the sublattices behave in an independent manner, and the magnetostriction in both Y_2Co_{17} and Dy_2Co_{17} closely approximates single-ion behavior. (DLC)

6262 (CONF-730402–(P1-2), pp 466-475) ANALYSIS OF RARE-EARTH CONTRIBUTION TO MAGNETIC ANISOTROPY IN RCo_5 AND R_2Co_{17} COMPOUNDS. Greedan, J. E.; Rao, V. U. S. (Univ. of Pittsburgh). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Variation of the easy direction of magnetization of RCo_5 and R_2Co_{17} with the rare earth is discussed. A modified single ion model is used to treat the rare-earth contribution to the anisotropy; the estimation of the crystal field interaction and the exchange field is shown. The direction preference of the rare earth sublattice is determined by the sign of B_2^0, which in turn is determined by the product of the signs of α_J and A_2^0. Predictions agree with experiment for the RCo_5 series except for $PrCo_5$. Agreement is also found for the $R_2Co_{17}(Th_2Zn_{17}$-type) and $(Th_2Ni_{17}$-type (I) series, but not for the $R_2Co_{17}(Th_2Ni_{17}$-type) (II) series. Comparisons are also made between point-charge model predictions and experiment. (19 references, 5 tables, 3 figures) (DLC)

6263 (CONF-730402–(P1-2), pp 476-484) SATURATION MAGNETIZATION OF RARE EARTH–TRANSITION METAL PHASES OF TYPE $R_2(Co,Fe)_{17}$. Mildrum, H.; Tront, J.; Hartings, M.; Strnat, K. (Univ. of Dayton, OH). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Saturation magnetization was measured as a function of iron content across the entire composition range, x = 0 to 1, for the six quasi-binary alloy systems with R = Ce, Pr, Nd, Sm, Y and MM (Ce-rich misch metal). In each system, the addition of iron raises the room temperature saturation above the values for the pure cobalt compounds to maxima at x ≈ 0.5 to 0.7. In the region between x = 0.1 and 0.5, where most of these phases (except those of Nd) have easy-axis crystal anisotropy, the magnetization values are favorably high for the engineering applications mentioned. Previously published information about the Curie temperatures and magnetic anisotropy is included. (13 references, 8 figures) (auth)

6264 (CONF-730402–(P1-2), pp 596-604) IMPORTANCE OF CRYSTAL FIELD ON MAGNETIC MOMENT ORIENTATION IN EQUIATOMIC RARE EARTH–NICKEL RNi COMPOUNDS (R = Tb to Tm). Gignoux, D. (CNRS, Grenoble, France); Paccard, D.; Rossat-Mignod, J.; Tcheou, F. 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Although the point-charge model is oversimplified and the exchange energy is not negligible, it is possible to interpret correctly the observed magnetic structure. The determination of the direction of magnetic moments depends only on the ratio V_2^{-2}/V_2^2 which eliminates the screening effects and the value of $\langle r^2 \rangle$. The moments lie in the mirror plane because the second-order parameter V_2^2 is prepondérent; so when $\alpha > 0$ (Er,Tm) the magnetic moments are in the OX direction and when $\alpha < 0$ (Tb, Dy, Ho) the magnetic moments are in the OY direction. For each compound the crystal field energy is greater than the exchange energy. The best agreement between experiments and calculations is obtained for $Tb_{0.5}Y_{0.5}Ni$ and TmNi for which T_0 is smaller than energy gap between the two low lying singlet states and the other excited states. For the other compounds, the positive exchange interaction changes the angle to increase the ferromagnetic component. Thus for the RNi compounds with FeB-type structure, the noncollinear structures essentially result from a compromise between isotropic positive exchange interactions and a strong single-ion anisotropy due to the effect of the crystal field on R^{3+} ion. The importance of the single-ion anisotropy is confirmed by the study of the $TbNi_{1-x}Cu_x$ compounds. An increase of the number of conduction electrons due to copper introduces negative interactions which stabilize transverse wave magnetic structures and not helimagnetic ones, the direction of magnetic moments is still that determined by the crystal field on Tb^{3+} ions. (3 figures, 4 tables, 18 references) (auth)

6265 (CONF-730402–(P1-2), pp 605-613) SPIN REORIENTATION IN $SmFe_2$. Atzmony, U. (Nuclear Research Centre, Beersheba, Israel); Dariel, M. P.; Bauminger, E. R.; Lebenbaum, D.; Nowik, I.; Ofer, S. 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In Proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

^{57}Fe Moessbauer absorption measurements were carried out in $SmFe_2$ between 4 and 300°K. Results show a wide transition region from 120 to 230°K, in which the direction of magnetization is not parallel to a major crystal axis. Instead, the direction changes continuously from [110] to [111]. The crystal field parameters necessary within the single ion model in order to explain the spin reorientation temperature in $SmFe_2$(180°K), are much larger than those for the heavier rare earth–iron Laves compounds. The experimental hyperfine field differences are not in agreement with those calculated assuming dipolar magnetic fields. (4 figures, 10 references) (DLC)

6266 (CONF-730402–(P1-2), pp 622-626) MAGNETIC PROPERTIES OF Ln_3In INTERMETALLIC COMPOUNDS. Hutchens, R. D. (Univ. of Pittsburgh); Wallace, W. E.; Nereson, N. 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Magnetic properties (Curie point, effective moment, $g\sqrt{J(J+1)}$, μ_{cr} (20 kOe), and Weiss constant θ_p) were measured for Pr_3In, Nd_3In, Gd_3In, Dy_3In, and Er_3In. Neutron diffraction measurements were also made on Nd_3In in order to determine whether the abnormally low moments of Pr_3In and Nd_3In are real. Possible reasons for the low Nd^{3+} moment are discussed. (DLC)

6267 (CONF-730401–(P1-2), pp 627-636) MAGNETIC SUSCEPTIBILITIES OF HEAVY RARE-EARTH METALS NEAR THE NÉEL POINTS. Boyarsky, L. A.; Starikov, M. A. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). 1973.

From tenth rare earth research conference, Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Measurements of χ were made on polycrystalline Tb, Dy, and Ho in the vicinity of the Néel points in order to study the phase transformations. In the paramagnetic region, the samples all obeyed the Curie–Weiss law, and μ_{eff} and θ are given. The derivative $d(\chi T)/dT$ vs lg τ ($\tau = |T - T_N|/T_N$) was studied for both branches $T < T_N$ and $>T_N$. χ of a Dy single crystal was also measured along the easy (a axis) and hard (c axis) magnetic axes. Results are described satisfactorily by Fisher's theory, except for a region $T > T_N$. A model for this behavior is suggested, and plots are made of the power $\gamma^* = (T - T_K)\, \partial/\partial T \ln 1/\chi$ for Tb, Dy, and Ho. The lengths of the helicoid in a helicoidal antiferromagnet is discussed. (7 figures, 3 tables) (DLC)

6268 (CONF-730402–(P1-2), pp 711-720) REVISED PHASE DIAGRAMS FOR BINARY SYSTEMS CERIUM–COBALT, PRASEODYMIUM–COBALT, AND NEODYMIUM–COBALT. Ray, A. E.; Biermann, A. T.; Harmer, R. S.; Davison, J. E. (Univ. of Dayton, OH). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30 –May 3, 1973.

The phase diagrams were investigated in more detail, using metallography, x-ray diffraction and DTA. Besides the graphical diagrams, crystal-structure data for the intermediate intermetallic compounds are also tabulated. (DLC)

6269 (CONF-730402–(P1-2), pp 728-736) ELASTIC BEHAVIOR OF POLYCRYSTALLINE RARE EARTH–IRON LAVES COMPOUNDS. Rosen, M.; Klimker, H.; Atzmony, U.; Dariel, M. P. (Nuclear Research Centre, Beersheba, Israel). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

The elastic moduli of polycrystalline rare earth–iron Laves compounds RFe_2 (R = Ce, Sm, Gd, Tb, Dy, Ho and Er) and YFe_2, were determined by means of an ultrasonic pulse technique at a frequency of 10 MHz, between 4.2 and 300°K. Anomalies in the elastic moduli were observed in $CeFe_2$ and $SmFe_2$. The data gives some insight into the peculiar magnetoelastic behavior of these compounds. (4 figures, 12 references) (auth)

6270 (CONF-730402–(P1-2), pp 737-745) ROLLING AND ANNEALING TEXTURES OF GADOLINIUM. Swift, W. M.; Reynolds, W. T. (Westinghouse Research Labs., Pittsburgh). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Textures of 99.9% Gd strips having reduction in thickness ranging from 30 to 90% were determined by the Schulz x-ray reflection method for samples as cold rolled and after annealing for two hours at 950°C. Strong basal-plane texture with a tendency for the $\langle 10\bar{1}0 \rangle$ direction to lie along the rolling direction occurred in the cold-rolled samples. The amount of (0002) texture diminished gradually as cold reduction increased to 80%. However, the basal plane texture sharpened upon annealing and intensified gradually with increased prior cold work. (2 tables, 2 figures, 19 references) (auth)

6271 (CONF-730402–(P1-2), pp 746-752) MECHANICAL AND ELECTRICAL PROPERTIES OF DILUTED Gd–Fe ALLOYS NEAR THE CURIE POINT. Nabutovskaya, O. A. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

A study was made of the electric resistance and microhardness of pure Gd and Gd containing 1 or 1.86% Fe in the neighborhood of the magnetic ordering point. The temperature coefficient of the resistance of pure Gd has a maximum at the Curie point (291.58°K), and this maximum is shifted toward higher temperatures and becomes smaller for the alloys with Fe. The microhardness shows a minimum and a maximum at 292.1 and 276.9°K for pure Gd, and splitting of these peaks occurs in the alloys, probably owing to unequilibrium phases. (DLC)

6272 (CONF-730402–(P1-2), pp 1007-1016) NUCLEAR MAGNETIC RESONANCE IN CsCl-STRUCTURE RARE-EARTH INTERMETALLIC COMPOUNDS. Schmidt, V. H. (Sandia Labs., Albuquerque, NM). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Knight shifts were measured for the magnetic compound CeMg and the nonmagnetic compounds ScNi, YAg, LaMg, LaZn–LaAg, LaAg–LaIn, YbCd, YbIn, LuCu, and LuPd. Results are plotted on a Knight Shift vs number of conduction electrons per unit cell graph. The temperature dependences of the shift, were also investigated. YbCd and YbIn being nonmagnetic indicates the existence of only Yb^{2+}. (14 references) (DLC)

6273 (CONF-730402—(P1-2), pp 1017-1026) MOESSBAUER AND CRYSTALLOGRAPHIC STUDY OF $DyFe_{3-x}Ni_x$ COMPOUNDS. Tsai, S. C.; Narasimhan, K. S. V. L.; Kunesh, C. J.; Butera, R. A. (Univ. of Pittsburgh). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

Moessbauer and crystallographic investigations were carried out on $DyFe_{3-x}Ni_x$ compounds crystallizing in the $PuNi_3$-type of structure. The hyperfine field observed at the iron sites shows a maximum at x = .75. The twelve-line spectrum observed at room temperature corresponding to the two different kinds of iron in the structure collapsed into a single six-line pattern at 4.2°K. The lattice parameter c shows a rapid decrease when x is increased beyond 2.0 but no such behavior was found in the a lattice parameter. Results of x-ray and Moessbauer data are explained in terms of site preferences and nonlocalized transition metal moments, respectively. (6 figures, 3 tables, 10 references) (auth)

6274 (CONF-730402–(P1-2), pp 1027-1033) CRYSTALLOGRAPHIC AND MOESSBAUER STUDY OF (Sc, Y, Ln) $(Fe, Al)_2$ INTERMETALLIC COMPOUNDS. Dwight, A. E.; Kimball, C. W.; Preston, R. S.; Taneja, S. P.; Weber, L. (Northern Illinois Univ., DeKalb). 1973.

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30 –May 3, 1973.

Crystal structures were studied in a series of alloys in the RFe_2–RAl_2 system in which R includes Sc, Y, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, Tm, and Lu. X-ray studies were made by the Debye–Scherrer method for arc-melted and annealed alloys. Earlier work had shown that where the composition is close to RFe_2 and RAl_2, the compounds are $MgCu_2$-type (cubic) Laves phases, but that in a composition region intermediate between RFe_2 and RAl_2 the compounds are $MgZn_2$-type (hexagonal) Laves phases. The present work defines the composition limits of the $MgCu_2$- and $MgZn_2$-type structures and reports the existence of a new $MgCu_2$-type compound based on $ScFe_2$. In general, the range of stability of the hexagonal compounds is shifted to higher aluminum concentration as the identity of the rare earth changes from Sm to Lu, although anomalous behavior is exhibited by Sc. When the regions of phase stability are depicted in a plot of volume per formula weight vs composition, the phase boundaries between cubic and hexagonal phases are curved, but have similar shapes at both the iron-rich and aluminum-rich end of the diagram. The tendency to order into the Mg_2Cu_3Si-type structure in the hexagonal phases was studied by means of the Moessbauer effect with ^{57}Fe; various models of this ordering are treated. (auth)

6275 (CONF-730402–(P1-2), pp 1046-1055) CALORIMETRIC STUDY OF SOME RARE-EARTH METALS AND THEIR COMPOUNDS $LnSn_3$. Percheron-Guegan, A. (CNRS, Bellevue, France); Achard, J. C.; Bacha, A.; Chatillon, C.; Mathieu, J. C. 1973. (In French).

From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

In proceedings of the tenth rare earth research conference, Carefree, Arizona, April 30–May 3, 1973.

The heats of solution of the rare earth metals in tin are negative and high (from 70 to 20 kcal), implying strong bonds between the rare earth and tin. With the exception of Eu and Yb, all the rare earth metals have a compact hexagonal structure, a conduction band of three electrons, and similar atomic volumes. Only the structure of their 4f shell differentiates them. A graph of dissolution as a function of the atomic number, Z, shows that its absolute value decreases linearly with Z. In the solid state metallic Yb and Eu have only two electrons in the conduction band, they have an exceptionally large atomic volume, and a cubic structure. If they behaved in solution as the other trivalent rare earth metals, their heats of solution would be found very far above the straight line for they would then undergo an electronic transition corresponding to the promotion of a 4f electron into the conduction band, the corresponding energy being estimated at 23 kcal for europium and 9 kcal for ytterbium. On the contrary, the experimental points are below the normal variation which excludes such a phenomenon. These two metals maintain their $4f^75d^2$ and $4f^{14}5d^2$ structure in solution, and their heat of dissolution is comparable to that of the alkaline earth metals. It can be said that $EuSn_3$ and $YbSn_3$ do not deviate particularly from the law of variation established for the compounds of the trivalent rare earths studied ($LaSn_3$, $GdSn_3$, and $SmSn_3$), and that Eu and Yb maintain their $4f^7$ and $4f^{14}$ structure. The heats of formation, much less elevated than for the other metallic compounds, indicate that at least part of the electrons in the conduction band must be localized, entailing a type of linkage that deviates from the scheme of metallic linkage. (DLC)

6276 (NAA-SR-Memo-7241) HIGH TEMPERATURE ULTRA-HIGH VACUUM SELF-WELD TESTING. Interim Report. Kellogg, L. G. (Atomics International, Canoga Park, Calif.). 28 Mar 1962. Contract AT(11-1)-GEN-8. 41p. Dep. NTIS $4.25. Declassified 3 May 1973.

Self-welding may be defined as the adhesion between surfaces of contacting materials. Tests have shown that galling, high starting friction, and seizure are direct results of this adhesion. A screening study was conducted to determine material combinations that exhibited the least amount of adhesion. This study involves the unit area loading of selected test specimens while the specimens are in the prescribed environment. Test conditions, procedures, and equipment used are described. Descriptions of the materials being evaluated and in some detail the results of the first ten combinations are included. Even though these results are preliminary, a significant point is the occurrence of self-welding under the conditions of high temperature and high vacuum. (auth)

6277 (ORNL–4855) HEAVY-SECTION STEEL TECHNOLOGY PROGRAM. Semiannual Progress Report for Period Ending August 31, 1972. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 78p. Dep. NTIS $3.00.

Programs devoted to extending and developing the technology for quantitatively assessing the margins of safety against fracture of the primary containment systems of civilian water reactors are described. Emphasis is on the pressure vessels. Practically all areas of materials technology as related to the pertinent steels and weldments have been or are being investigated. Results of research on unirradiated and irradiated materials are presented along with results of pressure vessel and pipe investigations. (JRD)

6278 (ORNL-TM-3734) EFFECT OF AGING TIME AND TEMPERATURE ON THE IMPACT AND TENSILE BEHAVIOR OF L-605: A COBALT BASE ALLOY. Bourgette, D. T. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 31p. Dep. NTIS $3.75.

The effect of aging temperature and time on the impact and tensile behavior of L-605 (Haynes 25 alloy) was studied over the range of 760 to 870°C and 50 to 4000 hr. Prolonged exposure at these temperatures resulted in severe alloy embrittlement. The principal embrittling reaction was the precipitation of the Laves phase, Co_2W. At the lower temperatures, however, the precipitation of Co_3W may have contributed to embrittlement. Maximum aging embrittlement occurred after 500 hr at 870°C. Impact testing of identically aged specimens at temperatures of 315 to 760°C revealed that 93% of the toughness was lost at the highest test temperature and that all fractures were intergranular. Impact testing at lower temperatures revealed a greater loss of toughness. Specimens aged at 760, 815, and 870°C and tensile tested at room temperature and 540°C showed a severe loss of ductility, the greatest loss occurring in specimens aged at 870°C. Specimens aged at 760°C for 1000 hr exhibited a ductility of 10% at room temperature and 28% at 540°C. Longer aging times (at 760°C) resulted in a continued loss of ductility. (auth)

6279 (RDT-M-2-2-T(5-73)) STAINLESS AND LOW ALLOY STEEL FORGINGS (ASME SA-182 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). May 1973. 13p. RSO.

A standard prescribing requirements for stainless and low alloy steel forgings (ASME SA-182) with additional requirements for nuclear and associated applications is presented. This standard supersedes RDT M2-2T, dated August 1972. (JRD)

6280 (RDT-M-2-5-T(5-73)) AUSTENITIC STAINLESS STEEL WELDING FITTINGS (ASME SA-403 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). May 1973. 13p. RSO.

A standard prescribing requirements for austenitic stainless steel welding fittings (ASME SA-403) with additional requirements for nuclear and associated applications is presented. This standard supersedes RDT M 2-5T, dated April 1972. (JRD)

6281 (RDT-M-3-1-T(5-73)) CARBON STEEL SEAMLESS PIPE (ASME SA-106 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). May 1973. 10p. RSO.

A standard prescribing requirements for carbon steel seamless pipe (ASME-M-3-1-T(573)) with additional requirements for nuclear and associated applications is presented. This standard supersedes RDT M 3-1T, dated July 1971. (JRD)

6282 (RDT-M-5-2-T(5-73)) CARBON STEEL PLATES (ASME SA-516 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). May 1973. 9p. RSO.

A standard prescribing requirements for carbon steel plates (ASME SA-516) with additional requirements for nuclear and associated applications is presented. This standard supersedes RDT M 5-2T, dated June 1972. (JRD)

6283 (RDT-M-5-3-T(5-73)) LOW ALLOY STEEL PLATES (ASME SA-533 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). May 1973. 8p. RSO.

A standard prescribing requirements for low alloy steel plates (ASME SA-533 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M-5-3T, dated July 1971. (JRD)

6284 (RDT-M-7-6-T(5-73)) PRECIPITATION-HARDENING STAINLESS STEEL BARS, SHAPES, AND FORGINGS (ASME SA-564 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). 21 May 1973. 13p. RSO.

A standard prescribing requirements for precipitation hardening stainless steel bars, shapes, and forgings (ASME SA-564 with additional requirements) for nuclear and associated applications is presented. (JRD)

6285 (UCRL-74078) APPLICATION OF STRIP STRAIN GAGES FOR MEASURING RESIDUAL STRESSES IN BERYLLIUM. Dittbenner, G. R. (California Univ., Livermore. Lawrence Livermore Lab.). 14 Sep 1972. 12p. (CONF-730511-1). Dep. NTIS $3.00.

From third international congress on experimental mechanics conference; Los Angeles, California, USA (14 May 1973).

Evaluation and application of tiny, 0.031-in. gage length, constantan foil strain gages for measuring residual surface stresses in beryllium parts is discussed. The strain gages were applied to one side of the beryllium parts at locations known to have high residual surface stresses. Small coupons were machined from the parts and the opposite side of the coupon was chemically milled with a 10 to 20% hydrochloric acid solution. The strain gage installation was protected with micro-crystalline wax. The etching process required approximately 20 h at 75°F. Glass-fiber reinforced epoxy-phenolic backed strain gages were selected for use because of their stability rather than the more readily available polyimide backed gages. Details of the strain gage installation are presented. (auth)

6286 INFLUENCE OF BORON ON THE PROPERTIES OF ELECTRON BEAM-MELTED MOLYBDENUM. Makunin, M. S.; Kharitonov, V. I.; Falaleeva, Z. S.; Shamrai, F. I. Izv. Akad. Nauk SSSR, Metal.; No. 5, 123-128(1972). (In Russian).

Solubility of B in solid Mo was studied from 1100 to 2150°C, and the effect of B (0.002 to 0.04 wt %) on the structure, grain size, elastic properties, and deoxidation capacity of B in Mo were investigated. It was concluded that the optimum concentration of B in Mo was from 0.005 to 0.01%. (KSW)

6287 PHASE DIAGRAM FOR Ru-Y. Savitskii, E. M.; Polyakova, V. P.; Roshan, N. R. Izv. Akad. Nauk SSSR, Metal.; No. 5, 129-132(1972). (In Russian).

The phase composition diagram for the Ru-Y system (to 2220°C) was constructed from physicochemical analysis methods. Two eutectics were established: one melting at 1840°C between Ru and the compound Ru_2Y, and a second melting at 1080°C between RuY_3 and the boundary of pure Y. (KSW)

6288 PERIODICITY OF EQUILIBRIUM DISTRIBUTION COEFFICIENTS OF IMPURITIES IN URANIUM. Kuchar, L. Jad. Energ.; 19: No. 5, 156-160(May 1973). (In Russian)

A systematic study was made of available equilibrium binary alloys with U as a base and in the region of low concentrations of impurities. The character of the solidus and liquidus curves and the values of the equilibrium distribution coefficients of separation of impurities from U were examined. Such impurities are known to exert a profound effect on the crystallization characteristics of these alloys. This study included a survey of the literature (55 references) on all available binary phase composition diagrams involving U and melting-point data on such systems. (KSW)

6289 MECHANICAL PROPERTIES OF ALLOYS IN THE Mo-B SYSTEM. Kharitonov, V. I.; Fedotov, S. G.; Makunin, M. S.; Shamrai, F. I.; Falaleeva, Z. S.; Sinodova, E. P. Izv. Akad. Nauk SSSR, Metal.; No. 5, 133-137(1972). (In Russian).

The elastic properties and microstructure of Mo-B alloys up to 0.04 % B were investigated. The effect of different annealing histories of the alloy samples was noted. (KSW)

6290 THERMOLUMINESCENCE AND ISOTHERMAL DECAY OF LUMINESCENCE IN X-RAY-COLORED NaCl CRYSTALS. Murti, Y. V. G. S.; Suryanarayana, D.; Murthy, K. R. N. (Indian Inst. of Tech., Madras). Indian J. Pure Appl. Phys.; 10: No. 11, 824-826(Nov 1972).

A prominent glow peak at 175°C (warming rate 40°C/min) associated with the first-stage F-centers in x-ray colored NaCl crystals is analyzed by various methods giving a trap depth of 1.36 eV and a frequency factor of 9.7×10^{13} sec^{-1}. The above analysis and isothermal studies on the luminescence decay are found consistent with first order kinetics. Based on a tentative identification of the filled traps with F-centers, the thermal excitation energy to the relaxed excited state of the F-center in NaCl is deduced to be 2.35 eV. (auth)

6291 DECOMPOSITION OF COBALT-VANADIUM SOLID SOLUTIONS. Zakharova, M. I.; Moshkov, V. V.; Dunaev, N. M. Izv. Akad. Nauk SSSR, Metal.; No. 5, 138-142(1972). (In Russian).

The disintegration of the supersaturated solid solution in Co-V alloys containing 15 and 20% V occurred directly with the separation of the equilibrium phase Co_3V; no intermediate metastable phase could be detected. An analysis of diffusion effects through x-ray studies provided information on aging temperatures in connection with the Co_3V phase and its crystal orientation. (KSW)

6292 STABILITY AND PHASE COMPOSITION OF QUENCHED TITANIUM ALLOYS. Kolachev, B. A.; Lyasotskaya, V. S.; Sovalova, E. G. Izv. Akad. Nauk SSSR, Metal.; No. 5, 147-150 (1972). (In Russian).

It was shown possible to predict qualitatively the dependence of mechanical properties of Ti alloys in the tempered state on the heating-quenching temperatures. Prediction of this type was facilitated by the use of the metastable phase diagram. Experimental data on alloys in the Ti-Mo and Ti-V systems confirmed the theoretical relationships. (KSW)

6293 PHASE EQUILIBRIA IN THE V-Zr-Cr SYSTEM. Eremenko, V. N.; Prima, S. B.; Tret'yachenko, L. A. Izv. Akad. Nauk SSSR, Metal.; No. 5, 151-154(1972). (In Russian).

The phase composition diagram for the ternary system V-Zr-Cr was constructed by methods of metallography, x-ray analysis, and melting point measurements. In the region $Zr-ZrCr_2-ZrV_2$, the existence of a three-phase equilibrium was established: $L \rightleftharpoons \beta-Zr + \gamma$, where γ is a solid solution $Zr(V, Cr)_2$ with a $MgCu_2$-type structure. When the Zr content is less than 40 at. % in the V-Zr-Cr system, the three-phase equilibria $L \rightleftharpoons \delta + \alpha$, $L + \delta \rightleftharpoons \gamma$, and $\delta \rightleftharpoons \gamma + \alpha$ are completed by a four-phase nonvariant equilibrium $L + \alpha + \gamma + \delta$ at 1560°C. The projection of the solidus in the V-Zr-Cr system was constructed. (tr-auth)

6294 INTERACTION OF LAVES PHASES IN SYSTEMS $Zr(Fe,Co,Ni)_2-ZrMn_2$. Pet'kov, V. V. Izv. Akad. Nauk SSSR, Metal.; No. 5, 155-157(1972). (In Russian).

X-ray studies, differential thermal, and microscopic analyses were used to obtain data on the Laves phases in the three binary systems $Zr(Fe, Co, Ni)-ZrMn_2$. These systems were characterized by the formation of restricted solid solutions based on binary compounds. (tr-auth)

6295 PHYSICO-MECHANICAL PROPERTIES OF TITANIUM-TUNGSTEN ALLOYS WITH CARBON DEFICIENCY IN THE CARBIDE SOLID SOLUTION LATTICE. Samsonov, G. V.; Chaplygin, F. I.; Vitryanyuk, V. K.; Abrarova, V. S. Izv. Akad. Nauk SSSR, Metal.; No. 5, 158-162(1972). (In Russian).

Conditions for producing solid alloys based on the complex carbide $TiC_x \cdot WC$, where $x < 1$, were established. Satisfactory physico-mechanical properties were possessed by alloys heated in a H_2 atmosphere, but baking in a vacuum, with consequent volatilization of CO, led to their embrittlement. Decrease the carbon content in the complex carbides $TiC_x \cdot WC$ caused an increase in the coercive force of the alloys, specific electrical resistance, an insignificant rise in hardness, and a decrease of strength upon bending. In alloys based on $TiCo_{0.6}-WC$, a phase η_1 existed similar to WC-Co alloys. (tr-auth)

6296 OPTICAL PROPERTIES OF Pr_6O_{11} THIN FILMS. Satyanarayana, M.; Vetury, R. (Andhra Univ., Waltair, India). Indian J. Pure Appl. Phys.; 10: No. 11, 844(Nov 1972).

Broad features of the results of ellipsometric, photometric, and allied measurements on thin films of Pr_6O_{11} are indicated. Experimental work is carried out on films of different thicknesses up to a maximum of $3\lambda/4$. Ellipsometric studies are made leading to a determination of n and k for different wavelengths by Vasicek's method. (JCW)

6297 LONGITUDINAL ULTRASONIC ATTENUATION IN THE SPIN SPIRAL STATE OF SINGLE-CRYSTAL HOLMIUM. Lee, M. C.; Levy, M. (Univ. of California, Los Angeles). J. Phys. Chem. Solids; 34: No. 6, 995-1005(Jun 1973).

Ultrasonic attenuation experiments were performed using 15- to 255-MHz longitudinal sound waves along the c-axis of single-crystal holmium. Without an external magnetic field, the attenuation increases in the spin-spiral state. This anomalous increase originates, at least in part, from the spin-phonon relaxation mechanism that is proposed, which states that the attenuation coefficient $\Delta\alpha_1 \propto \omega^2/(1 + \omega^2\tau^2)$, where τ is the longitudinal spin-phonon relaxation time.. The frequency dependence of the attenuation varies from $\omega^{1.0}$ to $\omega^{1.5}$, which suggests a frequency-dependent character for the spin-phonon relaxation time τ. A broad longitudinal attenuation maximum, which presumably is due to the competing processes between $\overline{S}$, J, and τ, is observed in the spin-spiral state, where $\overline{S}$ is the thermal average of the spin angular momentum per trivalent ion and J the Fourier transform of the exchange integral. An anomalous suppression of the longitudinal attenuation spike at T_N for frequencies higher than 165 MHz is unexplainable at present. The longitudinal spin-phonon relaxation time for Ho was determined, using experimental data. It has a T^{-3} temperature dependence. In the presence of an external magnetic field in the basal plane, the attenuation is decreased and a new peak and a plateau appear at the intermediate phase transitions. (auth)

6298 MAGNETIC PROPERTIES OF $DyFe_{3-x}Co_x$ AND $HoFe_{3-x}Co_x$. Narashimhanm K. S. V. L.; Butera, R. A.; Craig, R. S. (Univ. of Pittsburgh). J. Phys. Chem. Solids; 34: No. 6, 1075-1077(Jun 1973).

Magnetic moments and Curie and compensation temperatures were measured for $DyFe_{3-x}Co_x$ and $HoFe_{3+x}Co_x$ compounds. The variation of transition metal moment is explained on the basis of the rigid-band model. (auth)

6299 PHASE DIAGRAMS OF Cu–Nb–Cr ALLOYS RICH IN COPPER. Nikolaev, A. K.; Rozenberg, V. M. Izv. Akad. Nauk SSSR, Metal.; No. 5, 163-166(1972). (In Russian).

Isothermal sections of the ternary phase composition diagrams of the system Cu–Nb–Cr at 600 and 1000°C were constructed using the customary techniques of physiocochemical analysis. The addition of Nb to Cu–Cr alloys, as in the case of adding Cr to Cu–Nb, lowered the solubility of Cr or Nb in Cu in the solid state. Six phase regions were established in the portion of the Cu–Nb–Cr phase diagram investigated: α, α + Cr, α + Cr + $NbCr_2$, α + $NbCr_2$, α + Nb + $NbCr_2$, and α + Nb. The polythermal section of the quasibinary profile of Cu–$NbCr_2$ was constructed. The maximum solubility of $NbCr_2$ in Cu at the eutectic temperature of 1070°C was 0.7%; that at lower temperatures was also measured (down to 600°C). (tr-auth)

6300 THERMODYNAMIC PROPERTIES OF LIQUID ALLOYS OF U–Mn–Zn. Ishutin, A. V.; Lebedev, V. A.; Nichkov, I. F.; Raspopin, S. P.; Povasin, V. E. Izv. Akad. Nauk SSSR, Metal.; No. 5, 169-173(1972). (In Russian).

The state of U in Zn–Mn solutions, in compounds, and in equilibrium with saturated solutions, was investigated by means of emf measurements. Solubility studies showed that the introduction of Mn into Zn lowered the solubility in it of U insignificantly, but noticeably affected the thermodynamic properties of the solutions and the compounds in equilibrium with it. (KSW)

6301 AEROSOL RELEASE DURING HEATING OF BERYLLIUM. Vishnevskii, E. P. Izv. Akad. Nauk SSSR, Metal.; No. 5, 205-209(1972). (In Russian).

The intensity of aerosol release during the heating of Be in the range 1000 to 1300°C was evaluated by passing a current of air through the Be, and then cooling and filtering the air current. Hindrance to the vaporization of the Be was offered by a film of oxide. (KSW)

6302 CRYSTALLOGRAPHIC, MAGNETIC, AND EPR STUDIES OF RARE EARTH– AND YTTRIUM–COBALT LAVES PHASES. Burzo, E. (Inst. for Atomic Physics, Bucharest). Int. J. Magn.; 3: No. 1-3, 161-170(Sep 1972).

The structural and magnetic behavior of RCo_2 (R = Nd, Pr, Sm, Gd, Tb, Dy, Ho, Er) and YCo_2 intermetallic compounds is studied. The magnetic moments of Co and R atoms are coupled antiparallel for R = Gd, Tb, Dy, Ho, Er, while for R = Pr, Nd, and Sm this coupling is ferromagnetic. The temperature dependence of the spontaneous magnetization shows that some compounds present first-order transitions. The reciprocal susceptibility for the ferrimagnetic compounds exhibits a temperature dependence in agreement with Néel's law: $1/\chi = 1/\chi_0' + T/C' - \sigma'/T - \theta'$. The Curie constants C′ determined experimentally were corrected because of the thermal variation of the molecular field coefficients: $1/C = 1/C' - \gamma/\chi_0'$. The γ values are estimated from pressure studies. The effective moment of cobalt atoms for these compounds is $\mu_{eff} = 2.00 \pm 0.50\ \mu_B$. The thermal variation of reciprocal susceptibility for $PrCo_2$ and $NdCo_2$ may be interpreted considering in addition to Neel's law a paramagnetic term χ_p independent of temperature. The magnetic behavior of cobalt atoms is discussed. The results of the electron paramagnetic resonance measurements are correlated with the magnetic data. (12 figures, 7 tables, 37 references) (auth)

6303 CRYSTALLOGRAPHIC, MAGNETIC, AND EPR STUDIES OF RARE EARTH– AND YTTRIUM–NICKEL LAVES PHASES. Burzo, E. (Inst. for Atomic Physics, Bucharest); Laforest, J. Int. J. Magn.; 3: No. 1-3, 171-177(Sep 1972).

Magnetic measurements on the RNi_2 intermetallic compounds (R = Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, and Tm) and YNi_2 were performed from 4.2 to 700°K. YNi_2 presents Pauli paramagnetism while RNi_2 are ferromagnetic. In these systems, nickel has no magnetic moment, its configuration being probably $3d^{10}$. Above the Curie temperature, the reciprocal susceptibility follows a Curie–Weiss behavior, except for $SmNi_2$. The paramagnetic moments of these compounds coincide with those of rare-earth ions. For $SmNi_2$, if taking into account both the exchange and Van Vleck-type paramagnetism, the best agreement with the experimental data is obtained for a spin orbit coupling constant Λ/k_B = 384°K and an exchange parameter J_f/k_B = 8°K. The EPR measurements carried out on $GdNi_2$ lead to g_s = 1.980 and DH/T = 2.45 Gs/°K. The exchange integral J_{sf} = –0.022 eV. $\Sigma F(2k_FR_n)$ was calculated and, in agreement with T_p, a reduction of the Fermi wave vector comparatively to free electron model is observed. (10 figures, 3 tables, 23 refs.) (auth)

6304 INTERACTION OF $ZrCr_2$ WITH ZrV_2 AND $ZrMo_2$. Eremenko, V. N.; Prima, S. B.; Tret'yachenko, L. A. (Inst. of Problems in Materials Sciences, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 1, 54-56(Jan 1973). (In Russian).

Metallographic, thermographic, and x-ray investigations were carried out on cast, annealed, and hardened specimens within the temperature range 1150 to 1650°C of alloys of binary systems Zr–Cr in the domain $ZrCr_2$ and ternary systems Zr–V–Cr and Zr–Mo–Cr. Samples for investigation were prepared by means of arc melting in argon of iodide zirconium, molybdenum sintered in bars, and electrolytic vanadium and chromium (purity of starting components 99.7%). It was established that, in the Zr–Cr system, polymorphous transformation of the cubic modification of $ZrCr_2$ (structural type $MgCu_2$) into hexagonal (of $MgZn_2$ type) takes place at 1550°C in the domain $ZrCr_2$–Zr and at 1530°C in the domain $ZrCr_2$–Cr. Temperature of polymorphous transformation of $ZrCr_2$ increases up to 1850°C in the system Zr–Mo–Cr and up to 1560°C in the system Zr–V–Cr. The solubility of vanadium and molybdenum in cubic modification of $ZrCr_2$ by the sections $ZrCr_2$–ZrV_2 and $ZrCr_2$–$ZrMo_2$ is not limited up to complete substitution of chromium atoms. Molybdenum solubility in hexagonal modification of $ZrCr_2$ is ~50 at. % and that of vanadium is ~50 at. % and that of vanadium is ~1 to 2 at. %. The reasons for different solubility of metals of V and VI groups in hexagonal modification of $ZrCr_2$ are discussed. (auth)

6305 DISCONTINUOUS FORMATION OF LOCALIZED MOMENTS IN Nb–Mo(Fe). Maletta, H.; Rao, K. R. P. M. (Technische Univ., Munich). Int. J. Magn.; 3: No. 1-3, 5-9(Sep 1972).

Moessbauer effect studies of ^{57}Fe in Nb–Mo alloys lend experimental support to the hypothesis of Jaccarino and Walker, i. e. that the magnetic moment formation on the Fe impurities in this system is a discontinuous phenomenon. The magnetic hyperfine fields and the isomer shifts at the various Fe sites in these alloys are consistent with the model, emphasizing the influence of the local environment on the electronic density of states at the iron impurity. Moreover, an influence of the next nearest neighbors is observed, necessitating an improvement upon the simple model of Jaccarino and Walker. (auth)

6306 ELECTRONIC STRUCTURE OF INTERMETALLIC Gd COMPOUNDS WITH CsCl STRUCTURE. Oppelt, A. (Technische Hochschule, Darmstadt, Ger.); Dormann, E.; Buschow, K. H. J. Int. J. Magn.; 3: No. 1-3, 55-57(Sep 1972).

The magnetic order of CsCl-type compounds such as $GdGa_xCu_{1-x}$, $GdIn_xAg_{1-x}$, and $GdZn_xAg_{1-x}$ changes from antiferromagnetism to ferromagnetism with increasing conduction electron concentration. NMR measurements show that the hyperfine field at the nonmagnetic ions always remains negative. This result is unexpected within the RKKY approach based on a free electron model. An attempt is made to interpret the experimental data introducing a product J(q)f(q), which is constant up to the cutoff wave number $q = 2k_F$, and using different k_F values for the magnetic and nonmagnetic sites. (auth)

6307 NEUTRON DIFFRACTION STUDIES IN THE SYSTEM $ErAl_2$–$ErAl_3$. Will, G.; Bargouth, M. O. (Univ., Bonn). Int. J. Magn.; 3: No. 1-3, 87-92(Sep 1972).

In the binary system Er–Al, crystals of composition $ErAl_2$, $Er_xY_{1-x}Al_2$, and $ErAl_3$ were studied by neutron diffraction and their magnetic structures determined. In $ErAl_3$, two polymorphs, hexagonal and cubic, were investigated. Crystal field effects are large in these crystals and antiferromagnetic ordering is observed in both polymorphs below T_N = 5.1°K. The magnetic moment values are respectively 6.6 μ_B and 5.1° μ_B, much below the free ion value. $ErAl_2$ and its diluted members $Er_xY_{1-x}Al_2$ exhibit ferromagnetic ordering until an erbium concentration of about 30%. In all crystals, a moment of 8.8 to 9.0° μ_B is observed, which corresponds to the expected full moment for the free ion. (auth)

6308 REMARKS ON THE ELECTRONIC STRUCTURE AND ELECTRON CORRELATIONS IN ACTINIDES. Continentino, M. A.; Lopes, L. C.; Gomes, A. A. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis.; 19: No. 4, 105-140(1972).

One-electron propagators are obtained for the case of intra-orbital and inter-orbital repulsion. In both cases, one obtains Roth-like propagators, with V_{df} renormalized one electron f or d energies. These results generalize the previous ones obtained for transition metal systems, in the sense that the hybridizing bands are now Coulomb correlated bands. In the case of inter-orbital correlations, the exact energy matrix is taken into account, and the consequence of taking it exact is to introduce an effective mixing matrix element $|V_{sf}^{eff}|^2$, which accounts for the effect of fluctuations in occupation numbers of d and f bands. It is shown that for the case of intra-orbital repulsion, the approximations introduced in discussing the energy matrix can be removed. One recovers essentially the same result as in the inter-orbital case, obtaining for the effective mixing the same formal expression for the correction α_σ. The method of Roth is used to show that the self-consistent determination of the correlation functions involved in the definition of α_σ is feasible. Finally, the method of Kishore and Joshi (Phys. Rev., B2: 1411(1970)) is used to derive analytical expressions for the density of states. The program of performing the self-consistent determination of the occupation numbers (and consequently the magnetic state) can be performed in the same lines as in Roth's paper (Phys. Rev., 184: 45(1969) except for the hybridization effects which are treated in the same way as Kishore and Joshi, using the density of states. (auth)

6309 STABILIZATION OF THE CUBIC A15 PHASE OF Nb_3Sn. Viswanathan, R.; Johnston, D. C. (Univ. of California, San Diego, La Jolla). Contract AT-(04-3)-34-162. Mater. Res. Bull.; 8: No. 5, 589-592(May 1973).

From ac heat capacity measurements, it was found that copper-plating small Nb_3Sn samples appreciably inhibits the cubic–tetragonal transformation. (auth)

6310 PHYSICAL BASIS FOR SOLID-SOLUTION STRENGTHENING AND PHASE STABILITY IN ALLOYS OF TITANIUM. Collings, E. W. (Battelle-Columbus Labs., Columbus, OH); Gegel, H. L. Scr. Met.; 7: No. 5, 437-443(May 1973).

The decomposition of a solid-state property into components dependent on electron density, alloy compositions, and structure is discussed. Solid-solution strengthening is discussed in terms of electron perturbations for the two classes of Ti alloys: Ti–transition metal and Ti–nontransition metal. The strengthening mechanism in the latter is suggested to be one of strong dislocation pipning. 16 refs. (DLC)

6311 MAGNETIC PROPERTIES OF Co–W ALLOYS IN RELATION TO SINTERED WC–Co COMPACTS. Tillwick, D. L.; Joffe, I. (Univ. of the Witwatersrand, Johannesburg). Scr. Met.; 7: No. 5, 479-484(May 1973).

Co–W alloys with 0 to 20 wt.% W were prepared by homogenization at 1200°C. Their saturation magnetization δ_s decreases linearly with increasing W content (1.33% per wt.% W). The change of δ_s to be expected for the precipitation of 1 wt.% W from the fcc binder phase of WC–Co was calculated for the three forms of precipitation: WC, Co_3C, and Co_3W_3C. The time behavior of δ_s and coercivity of a Co–18.5 wt.% W alloy is plotted for ageing at 700°C; results suggest that the solubility at 700°C is ~7.8 wt.% W, and that the precipitation of Co_3W proceeds in a complex manner. (DLC)

6312 THERMOTRANSPORT OF BERYLLIUM AND MERCURY IN LIQUID SODIUM. Bhat, B. N.; Murarka, S. P.; Swalin, R. A. (Univ. of Minnesota, Minneapolis). Scr. Met.; 7: No. 5, 523-527 (May 1973).

Alloys were prepared of pure liquid Na with ^7Be or ^{203}Hg and held in a temperature gradient long enough to attain the stationary state. Specific activities were obtained for sections of the samples, and heats of transport were obtained from the slopes of log retative concentration vs reciprocal temperature: −6400 ± 2100 and +1700 ± 600 cal/g atom for Be and Hg, respectively. Intrinsic contributions to the heat of transport are also estimated: −1400 and +1500 cal/g atom. (DLC)

6313 RARE-EARTH CONTRIBUTION TO THE MAGNETIC ANISOTROPY IN RCo_5 AND R_2Co_{17} COMPOUNDS. Greedan, J. E.; Rao, V. U. S. (Univ. of Pittsburgh). J. Solid State Chem.; 6: No. 3, 387-395(Mar 1973).

An attempt was made to treat the rare earth contribution to the magnetocrystalline anisotropy in RCo_5 and R_2Co_{17} compounds with a single ion model using a Hamiltonian of the form $H = B_2^0O_2^0 + g\mu_BJ \cdot H_{ex}$. H_{ex} is regarded as arising mainly from the cobalt sublattice. Eigenvalues and eigenfunctions for the above Hamiltonian were obtained when the exchange field is perpendicular to the c-axis and compared with those when it is parallel to the c-axis. For values of H_{ex} estimated from experiment, it is found that the sign of B_2^0 determines the direction preference of the rare earth sublattice magnetization. Comparison of theory with experiment shows that the correct sign of B_2^0 can be predicted on the point charge model considering only the effect of rare earth nearest neighbors. The calculations also predict that the quantity $|K_{1R}(0) + K_{2R}(0)|$ is nearly equal to the crystal field overall splitting (CFOAS) determined in the absence of exchange and is independent of the magnitude of the exchange field, provided that the exchange field is sufficiently large. The temperature dependence of $|K_{1R} + K_{2R}|$ was also calculated and found to agree semiquantitatively with available experimental results. 5 tables, 20 refs. (auth)

6314 EFFECT OF ROOM TEMPERATURE PRE-STRAIN ON GRAIN BOUNDARY CAVITATION IN NIMONIC 80A. Dyson, B. F.; Henn, D. E. (National Physical Lab., Teddington, Eng.). J. Microscopy; 97: No. 1–2, 165-170(Jan 1973).

Specimens of the alloy Nimonic 80A were pre-strained 11% in tension at room temperature and then heated to 750°C for various times, either with or without application of stress. Examination by means of a high-voltage electron microscope revealed large numbers of spherical submicron diameter cavities. The cavities all lay on grain boundaries but were inhomogeneously distributed; a grain boundary usually contained either many cavities or none at all. It is concluded that the cavitation is a direct result of decohesion at the grain boundaries during the pre-straining and not due to any creep process. (auth)

6315 INVESTIGATION OF STRESS-DEFORMED STATE OF COPPER–MOLYBDENUM COMPOSITION USING A MICROHARDNESS METHOD. Gindin, I. A.; Somov, A. I.; Starodubov, Ya. D.; Chernyi, O. V. (Physical-Technical Inst. of Low Temperatures, Kharkov). Probl. Proch. Mashinostr.; No. 9, 56-59(Sep 1972). (In Russian).

The stress-deformation state was studied in a Cu–Mo composition both with a continuous and with a discrete hardening agent, using a microhardness method. Diagrams of stress and deformation intensities were constructed for a number of sections. At the moment of failure of a Mo platelet in the matrix, the most strongly deformed sections were situated at an angle of 45° to the applied force. A mechanism of the macroscopic deformation of the matrix was advanced. (tr-auth)

6316 TUNGSTEN NEWS, APRIL 1973. Tungsten News; 1-18 (Apr 1973).

Research and development activities in W technology are reviewed. Information is included on W metal, refractory W compounds for tool materials, W base alloys, W as an additive to alloys, recovery and processing of W, and other W compounds. 294 references are included. (JRD)

6317 Zr Hf NEWSLETTER, MARCH 1973. Akron, NY; AMAX Specialty Metals Division (1973). 14p.

Research and development activities in hafnium-zirconium technology are reviewed. Information is included on Hf metal, Hf alloys, Zr-base alloys, Zr as an additive to alloys, Hf compounds, Zr compounds, and uses of chemicals containing Zr. 246 references are included. (JRD)

6318 INFLUENCE OF HIGH-TEMPERATURE VACUUM ANNEALING ON MECHANICAL PROPERTIES OF A MOLYBDENUM WIRE. Nechiporenko, E. P.; Kirillov, V. S.; Lukirskii, Yu. V. Izv. Akad. Nauk SSSR, Metal.; No. 6, 149-154(1972). (In Russian).

A period of 10-min. annealing of Mo wire of industrial grade at 2000°C in a vacuum did not result in recrystallization embrittlement, but significantly improved its ductility. The residual gas content in the vacuum chamber before and after annealing at different temperatures was compared. (tr-auth)

6319 SOLUBILITY OF ZIRCONIUM IN LIQUID ZINC. Ishutin, A. V.; Lebedev, V. A.; Nichkov, I. F.; Raspopin, S. P. Izv. Akad. Nauk SSSR, Metal.; No. 6, 75-77(1972). (In Russian).

The solubility of Zr in liquid Zn in the temperature range 650 to 850°C was determined by emf measurements. The solubility, X_{Zr}, expressed as an atom fraction, was lg X_{Zr} = 1.896 – 3273/T for 650 to 760°C, and lg X_{Zr} = 1.060 – 2409/T for 760 to 850°C. (KSW)

6320 VARIATIONS OF MOLAR VOLUMES AND SURFACE TENSION IN Ga–In–Sn ALLOYS. Sukhman, A. L.; Yatsenko, S. P.; Kononenko, V. I. Izv. Akad. Nauk SSSR, Metal.; No. 6, 94-95(1972). (In Russian).

Densities and surface tensions were determined in the ternary system Ga–In–Sn. Values for the molar volumes and surface tension implied an anomaly in properties in the region of medium compositions, caused by the interaction of alloy components with each other. With a rise in temperature the system approached ideality. (tr-auth)

6321 THERMAL PROPERTIES OF LIQUID NEODYMIUM. Mardykin, I. P.; Kashin, V. I.; Vertman, A. A. Izv. Akad. Nauk SSSR, Metal.; No. 6, 96-98(1972). (In Russian).

The heat capacity of liquid Nd exceeded values characteristic of other metals. Thermal and electric conductivity of Nd changed very little during fusion. Most measurements were made at 1300 to 1600°K. (tr-auth)

6322 METALLOGRAPHY OF CAST TUNGSTEN. Savitskii, E. M.; Povarova, K. B.; Makarov, P. V.; Ugaste, Yu. E. Izv. Akad. Nauk SSSR, Metal.; No. 6, 177-185(1972). (In Russian).

Nonmetallic inclusions were investigated in a series of grades of fused W. Carbon participated in such inclusions as the carbide, O as the oxide, etc., and the morphology and distribution of these inclusions depended on the rate of cooling of the metal as it crystallized. Nonmetallic inclusions (carbide, in particular) were located in the grain boundaries, initiating cracks at the boundaries, and subsequent transcrystal cleavage. Alloying and an increase in the cooling rate affected the fine structure of W, promoting a polygonal structure and an increase in dislocation density. (tr-auth)

6323 EFFECT OF SUBSTITUTED ELEMENTS ON PROPERTIES OF TANTALUM. Gulyaev, A. P.; Selyanskaya, N. P.; Vasyukov, G. Kh. Izv. Akad. Nauk SSSR, Metal.; No. 6, 205-209 (1972). (In Russian).

The properties of binary Ta alloys with Nb, Ti, V, W, Mo, and Zr that form solid solutions were investigated in a range of concentrations from 5 to 50 at. %. The addition of 27% of V increased the hardness of the unalloyed Ta by a factor of three; Nb had little effect. Ti and Zr occupy intermediate positions. Ductility and impact strength remained at a high level despite increased hardness. Nb, V, Mo, and W have only a weak effect on the transition temperature of Ta from a viscous state to a brittle one. Ta alloys which contain 50 at. % Nb, 27 at. % V, 4 at. % Mo, or 5 at. % W maintain a high impact strength and 100% of the fibrous fracture down to –253°C. Alloying elements from Group IV of the Periodic Table (Ti, Zr) noticeably affect temperature curves of the impact resistance. More than 19 at. % Ti decreased the impact resistance of Ta at low temperatures. Additions of Zr also had an adverse effect on the impact strength. (tr-auth)

6324 STRENGTHENING OF NICHROME BY DISPERSED OXIDE PARTICLES. Abramov, I. V.; Golovanenko, S. A.; Maslenkov, S. B.; Abramov, O. V. Izv. Akad. Nauk SSSR, Metal.; No. 6, 227-230(1972). (In Russian).

Nichrome alloy was hardened by the addition of finely dispersed particles of ZrO_2 or Al_2O_3. Electron microscope studies of deformed Nichrome which had been thus hardened indicated a high stability of the ZrO_2 inclusions at 1200°C. (tr-auth)

6325 PHASE FORMATION IN THIN TANTALUM FILMS. Palatnik, L. S.; Obol'yaninova, O. A.; Naboka, M. N.; Gladkikh, N. T.; Khotkevich, V. I. Izv. Akad. Nauk SSSR, Metal.; No. 6, 171-176(1972). (In Russian).

The composition of a molecular beam during the thermal volatilization of Ta was studied, e.g., the variability of the ratio between the particles Ta, TaO, and TaO_2 with annealing temperature. The effect of the composition of the molecular beam on the structure and phase composition of thin Ta films was studied, showing that a beam of only Ta particles tended to form a fcc structure, and the latter was altered to the bcc structure with increase in thickness of the film. The presence of TaO and TaO_2 in the molecular beam resulted in a variety of phases in the condensed film: Ta, TaO, TaO_2, and Ta_2O_5. TaO manifested an isostructure with fcc Ta. β–Ta was not detected in condensed films. (tr-auth)

6326 ELECTRON TRANSFER IN Sb–Cd ALLOYS AT 500°C. Belashchenko, D. K.; Plotnikov, E. E. Izv. Akad. Nauk SSSR, Metal.; No. 4, 108-113(1972). (In Russian).

Alloys of Sb–Cd containing 5, 15, 30, 45, and 60 at. % Sb were used in a study of the electron transfer of the alloys at 500°C. The relative densities of the electron states at the Fermi level were calculated. The value g = 1.17 ± 0.07 characterized pure liquid Sb. The behavior of the ternary alloy Sb–Cd–Sn was examined and showed results similar to those for Sb–Cd. (KSW)

6327 OPTIMAL DESIGN OF EXPERIMENTS FOR INVESTIGATION OF THE PROPERTIES OF Ti–V–Al ALLOYS. Elyutin, O. P.; Kalinin, G. P.; Sobolev, N. N.; Chemleva, T. A. Izv. Akad. Nauk SSSR, Metal.; No. 4, 234-238(1972). (In Russian).

A mathematical method was developed for the systematic planning of experimentation with the aim of investigating the phase composition diagram–specific electrical resistance of alloys in the multiphase region of the Ti–V–Al system with up to 10% Al and up to 40% V. The mathematical model may utilize a computer program for greater effectiveness. (KSW)

6328 ELECTRICAL RESISTANCE OF Mo–W ALLOYS AT HIGH TEMPERATURES. Vertogradskii, V. A. Izv. Akad. Nauk SSSR, Metal.; No. 4, 220-222(1972). (In Russian).

The electrical resistance of the alloy Mo–50% W in the temperature range 1200 to 3000°K was compared with that of pure Mo and W. The validity of L. Nordheim's rule with respect to this alloy and a number of other binary systems with transition metals was established. (KSW)

6329 MECHANICAL PROPERTIES OF Ti–Mo ALLOYS AT LOW TEMPERATURES. Mikheev, V. S.; Nikitin, P. N.; Koshelev, P. F. Izv. Akad. Nauk SSSR, Metal.; No. 4, 216-219(1972). (In Russian).

Four Ti–Mo alloys, containing 1, 4, 7, and 11 wt % Mo, were used in a study of the effect of composition on physical properties of the alloys from +20 to –196°C. Toughness increased with increase in Mo content, whereas ductility decreased; these changes were much more noticeable at –196° than at +20°C. (KSW)

6330 DETERMINATION OF THE EUTECTIC CONCENTRATIONS IN BINARY METAL SYSTEMS. Fomichev, O. I.; Mal'chenko, T. M.; Spiridonova, I. M. Izv. Akad. Nauk SSSR, Metal.; No. 4, 214-215(1972). (In Russian).

Eutectic structures were induced to form from non-eutectic compositions by slight supercooling. A tabular summary of 30 binary metal systems is presented, including the following: Zn–In, Cd–Zn, Cd–Pb, In–Ga, Cd–Tl, and Cd–Bi. (KSW)

6331 TUBES FOR REACTOR CONSTRUCTION. Buchner, K. H.; Jakusch, H.; Souresny, H. Berg-Huettenmaenn. Monatsh.; 117: No. 5, 181-190(May 1972). (In German).

Tube materials used in reactors are reviewed and the compositions of the various alloys used in thermonuclear and fast reactors are listed. These include Cr–Mo, Cr–Ni, Cr–Ni–Mo, and Cr–Ni–Nb steels; Ni–Cr–Fe, Ni–Cu, Cu–Zn, Zr–Nb, Zr–Cu-alloys, and alloys based on Al, Be, and Mg. The service requirements of these materials, which are used for the core; primary and secondary circuits; cladding tubes for fuel elements; and heat-exchanger tubes, are discussed and methods for testing tubes for defects, e.g., ultrasonic testing are mentioned. Extrusion, stretch-reducing, cold pilgering, and various types of cold drawing operation for the production of tubes are briefly outlined and illustrated. (Metals Abstr.)

6332 REACTIONS OF GRAPHITE WITH TITANIUM AND ZIRCONIUM. Ushakov, B. F.; Zagryazkin, V. N.; Panov, A. S. Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 11, 1690-1693(Nov 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 11, 1921-1925(Nov 1972).

The kinetics of carbide formation in the systems Ti–C and Zr–C were studied and the reaction diffusion coefficients were determined. It is shown that, at 1200°C or below, formation and growth of the TiC and ZrC layers are determined by boundary reactions. At higher temperatures (1300 to 1400°C or above), diffusion processes become the determining stage of the growth of carbide layers. The equations of the temperature dependences of the reaction diffusion coefficients of carbon in TiC and ZrC have to form D_{TiC} = 0.065 exp (–64,500/RT) cm^2/sec, and D_{ZrC} = 0.37 exp (–76,200/RT) cm^2/sec. (23 references) (auth)

6333 MAGNETIC PROPERTIES OF VANADIUM NITRIDE AND DIBORIDE AND ALLOYS IN THE SYSTEM V–B–N. Aivazov, M. I.; Gurov, S. V. (Inst. of New Chemical Problems, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 11, 1682-1685(Nov 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 11, 1913-1916(Nov 1972).

The magnetic susceptibility was investigated in the region of homogeneity of VN_{1-x}, $VB_{2\pm x}$, and certain alloys in the system V–B–N with NaCl and AlB_2 structures. It was shown that these alloys contain two groups of electron localization levels, separated by a narrow energy gap. The dependence of the antiferromagnetic Curie point on the number of unpaired d electrons and the degree of exchange interaction of the cation–anion bond is shown. (auth)

6334 PHASE EQUILIBRIUM IN THE SYSTEM Cd–Te. Tomson, A. S.; Davydov, A. A.; Grigorovich, S. M. Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 11, 1674-1676(Nov 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 11, 1905-1907(Nov 1972).

The P–T–X phase diagram of the system Cd–Te was previously subjected to thermodynamic processing. The regions of existence of regular solutions in the system Cd–Te were distinguished by comparing the values of the intermolecular interaction energies that were calculated from the data of the P–T and T–X projections of the phase diagram. The results were used to calculate the liquidus line in the system Cd–Te and the P–T–X phase diagram for small deviations of the solution composition from the composition of the chemical compound. The liquidus line in the system Cd–Te agrees closely with the calculated line. (JCW)

6335 CRYSTAL STRUCTURE AND ELECTRICAL PROPERTIES OF ALLOYS OF THE SYSTEM $In_2Se_3-Sb_2Te_3$. Belotskii, D. P.; Legeta, L. V. (Chernovtsy State Univ., USSR). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 11, 1677-1681(Nov 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 11, 1908-1912(Nov 1972).

The results of an x-ray analysis of homogenized alloys confirmed the phase diagram of the system $In_2Se_3-Sb_2Te_3$. The boundaries of the $\beta-In_2Se_3$- and Sb_2Te_3-based solid solutions were determined and a chemical compound was found. Sixteen alloys with concentration ranges 1–2, 1–5, and 1–10 mole % and the initial components were investigated. The results of indexing of the x-ray-diffraction pattern of Sb_2Te_3 (a = 4.24 A, c = 30.39 A) agree with the data of Kuznetsov and Palkina. The values of the a and c constants of In_2Se_3 agree closely with the literature data. The x-ray-diffraction patterns of the alloys quenched from 500°C confirm the fusibility diagram of the system. The electric conductivities and thermo-emfs of the alloys were measured throughout the range of compositions. (JCW)

6336 ORDERING IN THE SYSTEM $ZrO_2-Y_2O_3$. Barker, W. W. Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 11, 1812 (Nov 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 11, 2057(Nov 1972).

In an experiment of heating $Zr_2Y_2O_7$ at 950°C for 10,000 h, neutron diffraction did not reveal the pyrochlore structure, but some weak effects were observed that might be due to formation of a compound, but not with the pyrochlore structure. A specimen of $Zr_2Ho_2O_7$ was also annealed at 950°C for 10,000 h and investigated by x-ray diffraction; no superlattice reflections of the pyrochlore type were observed. (JCW)

6337 ELECTRICAL CONDUCTIVITY, THERMO-EMF, AND THERMAL CONDUCTIVITY OF SEMICONDUCTIVE $CuInTe_2$ AND $CuGaTe_2$. Berger, L. I.; Isaev, Z. A. (All-Union Scientific Research Inst. of Chemical Reagents and Very Pure Chemicals, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 11, 1773-1775(Nov 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 11, 2018-2020(Nov 1972).

Results are given of investigations of the temperature dependences of the electric conductivity σ and thermo-emf, α, of $CuInTe_2$ and $CuGaTe_2$ in the solid and liquid states up to 960°C and of the thermal conductivity κ up to 550°C. Specimens were synthesized by fusing the components in evacuated and sealed capsules. Thermographic analysis and investigations of the microstructure and microhardness revealed that the synthesized specimens were one-phase; α was measured by the contact method, κ by the absolute method under steady thermal conditions. Investigations of $CuInTe_2$ and $CuGaTe_2$ revealed that their σ and κ temperature dependences are similar and differ little from the absolute values. (JCW)

6338 FORBIDDEN-ZONE WIDTHS OF SOLID SOLUTIONS $CdIn_2Se_4-CdIn_2Te_4$. Koval, L. S.; Radautsan, S. I.; Sobolev, V. V. (Inst. of Applied Physics, Kishinev, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 11, 1776-1777(Nov 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 11, 2021-2022(Nov 1972).

The results are examined of an investigation of the edge absorption of $CdIn_2Se_{4x}Te_{4(1-x)}$, (x = 0, 0.1, 0.2, 0.4, 0.6, 0.8, 0.9, 1.0) to determine the forbidden-zone width and its dependence on composition. The specimens were obtained by chemical-transport reactions (single crystals) and zone refining (large block polycrystals). X-ray phase analysis revealed that the change in the lattice constant with the composition obeys the Vegard law. The forbidden-zone width is known only for the initial compounds $CdIn_2Se_4$ and $CdIn_2Te_4$. (JCW)

6339 SOLUBILITIES AND PARTITION COEFFICIENTS OF Te AND Se IN EPITAXIAL LAYERS OF InSb. Volkov, A. S.; Galavanov, V. V.; Saimkulov, Z. A. (Ioffe Inst. of Physics and Tech., Leningrad). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 11, 1788-1789(Nov 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 11, 2033-2034(Nov 1972).

An investigation was made of doping epitaxial layers of InSb with impurities of selenium and tellurium. A method, based on the Moss–Burshtein effect, was used to determine the concentration of the ionized Te and Se atoms. Data from plots of the concentrations in the epitaxial layer vs. their concentration in the fused solution reveal solubility data and dependences of the partition coefficients on the concentrations in the melt are represented. It is shown that crystals grown by the Czochralski method obtained for the partition coefficients of Te and Se are lower than those obtained in this experiment. (JCW)

6340 PRESENT SITUATION AND PROBLEMS OF MATERIALS FOR THE TURBINES FOR NUCLEAR POWER GENERATION. Hoashi, J.; Miyazaki, M. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan). Karyoku Hatsuden; 23: No. 7, 743-749 (Jul 1972). (In Japanese).

Items relating to the selection of turbine materials are (1) low temperature and low pressure in comparison with thermal plants, and no need of heat resisting steel with high rupture strength, (2) prevention of blade erosion due to operation in wet steam range, (3) prohibition of feed treating agents because of radiation effects, and necessity of adopting corrosion resistant materials, (4) selection of corrosion resistant materials for pipings of highly wet steam, and (5) control of leak in condensers, and prevention of corrosion of condenser tubes. Clean steels are necessary for turbine rotors, shafts, and disks, and deoxidation in vacuum with carbon is carried out. Stress relieving is required for every last stage disk in order to prevent deformation, because long blades are attached to them. It was confirmed that the steel made by electro-slag remelt is satisfactory for the last stage disks. In order to prevent the erosion, stellite plates are brazed on last stage blades, blades with grooves for separating drain are employed for several low pressure (LP) stages, and flame hardening is carried out on ridges. 2Cr cast steel and 0.4Cr–1.4Ni alloy cast iron are used for diaphragms. Cu-containing cast steel and Cu-containing steel plates are used for high pressure (HP) and LP casings respectively, and for the prevention of erosion due to drain, austenitic stainless steel is welded on sealing surfaces. Condenser tubes and tube plates are sealed by expanding with strict control, and reliability equivalent to welding can be obtained. Thermal fatigue test is suitable for the welded parts of stainless steel tubes and tube plates of feed heaters. Cu-containing steel is used for the pipings of steam with high moisture and dissolved oxygen content. (JA)

6341 TEMPERATURE EFFECTS IN QUADRUPOLE INTERACTION IN NbHf ALLOYS. Klyucharev, V. A.; Bozhko, V. P.; Bulatov, A. S. (Physical-Technical Inst., Kharkov). Zh. Eksp. Teor. Fiz.; 64: No. 4, 1336-1341(Apr 1973). (In Russian).

Quadrupole interaction in Nb–Hf alloys containing 0.035, 0.1, 0.25, 0.5, 2, 10, 20, and 50% of Hf is studied in the normal (T = 300, 78, and 20°K) and superconducting phases (at 4.2°K) are studied by the perturbed angular $\gamma\gamma$-correlation technique. Alteration of smearing out of the local electric field gradient in alloys containing 2 and 10 at. % of Hf is observed in the normal phase on lowering of the temperature from 300 to 78°K. No changes in the quadrupole coupling parameters are observed in the temperature range 300 to 20°K. Qualitative changes in the nature of quadrupole coupling are observed in the superconducting phase of alloys containing 2, 10 and 50 at. % of Hf which at present cannot be interpreted. (auth)

6342 INTRINSIC COERCIVE FORCE IN $(Pr,Sm)Co_5$ AS A FUNCTION OF SAMARIUM CONTENT. Carriker, R. C. (Hamilton Metal Science, Division of HMW Industries, Lancaster, Pennsylvania 17604). Appl. Phys. Lett. 22: No. 4, 160-161 (15 Feb 1973).

A strong dependence of the intrinsic coercive force on the amount of samarium present in $(Pr,Sm)Co_5$ permanent magnets has been observed. These magnets were nominally 63 wt% Co, with five compositional variations in the rare-earth content ranging from 20.70 wt% Pr–16.30 wt% Sm to 27.75 wt% Pr–9.25 wt% Sm being studied. The sintering temperatures were varied for each composition, holding the sintering time constant at 30 min. The maximum intrinsic coercive force achieved during sintering increased rapidly with samarium content from 2.6 kOe for the 9.75 wt% Sm alloy to 22.4 kOe for the 16.3 wt% Sm alloy. (auth)

6343 MICRODYNAMICS OF INITIAL PLASTIC FLOW IN TUNGSTEN POLYCRYSTALS. Tandon, K. N. Stony Brook, NY; State Univ. of New York (1972). 83p. University Microfilms Order No. 73-12,080.

Thesis (Ph.D.).

Investigation of the microdynamics of initial flow in high-purity tungsten polycrystals was carried out at room temperature with a view towards correlating the initial microflow behavior with the observed dislocation structure. Experiments were designed to obtain all pertinent micro-mechanical data such as micro-stress–strain and the simultaneous time derivatives of stress and strain by employing multichannel recording techniques. Etch-pit microstructure was studied at progressively higher-stress levels, and measurements were analyzed for values of the dislocation velocity, which were typically $\approx 10^{-5}$ cm/sec, for the initial dislocation sources activated. It was found that after activation dislocations did not move immediately to the grain boundary but rather moved a characteristic distance of $\approx 2 \times 10^{-3}$ cm that was only weakly dependent on applied stress for all strains $<10^{-4}$. The source production rate was also investigated for a large number of grains. Values of $\approx 4 \times 10^4$ (kg/mm^2)cm^2 were typical for the pre-yield region with this rate being independent of initial source density of a grain. For constant stress, a fixed number of dislocations (observed as a fraction of the total dislocation density) moved at constant velocity whereas in dynamical conditions the mobile dislocation density was not constant because of continual dislocation generation. This behavior caused a two-stage parabolic microyielding that could be interpreted according to these present observations as related to the slip mean free distance that dislocations moved. Upon activation all dislocations did not become part of the total mobile density for all higher stresses, but rather most became trapped by localized obstacles. At stresses approaching second microstage, these sources broke away and more new slip sources were generated; for them, only the grain boundary acted as an obstacle. Some comparison studies on Fe–3%Si were also carried out. (Diss. Abstr. Int., B)

6344 ELECTROTRANSPORT AND DIFFUSION OF Co, Fe, AND Ag IN γ-CERIUM. Cathey, W. N. (Univ. of Nevada, Reno); Murphy, J. E.; Woodyard, J. R. Sr. Met. Trans.; 4: No. 6, 1463-1467(Jun 1973).

Electrotransport mobilities and diffusion coefficients were obtained for radiotracer impurities of Fe, Co, and Ag in Ce. The iron and cobalt moved toward the anode with mobilities of $\sim 10^{-3}$ cm^2/v-s in the range of 550 to 650°C. The silver moved to the cathode with mobilities of $\sim 10^{-5}$ cm^2/v-s in the range of 600 to 700°C. The diffusion coefficients obtained fit an Arrhenius equation $D = D_0 e^{-\Delta H/RT}$ with the following parameters: Fe: $D_0 = 3.3 \times 10^{-4}$, $\Delta H = 4.6$ kcal/mole; Co: $D_0 = 10^{-2}$, $\Delta H = 11$ kcal/mole; and Ag: $D_0 = 1.4$, $\Delta H = 28$ kcal/mole. The results are compared with other rare-earth diffusion data, and the possibility of a substitutional–interstitial diffusion mechanism is considered. (18 references) (auth)

6345 PHASE EQUILIBRIA IN THE METAL-RICH SIDE OF THE Ta–N SYSTEM. Geils, R. H.; Potter, D. I. (Union Coll., Schenectady, NY). Met. Trans.; 4: No. 6, 1469-1474(Jun 1973).

The region of the Ta–N system with nitrogen content less than 20 at.% and temperature between 350 and 1200°C was investigated using electron microscopy and diffraction and x-ray diffraction. For temperatures above 790°C, the hexagonal nitride Ta_2N was observed to form. Below this temperature two interstitially ordered cubic nitrides were observed. The higher temperature cubic nitride was found to be an equilibrium phase of approximate composition Ta_9N_2; a crystal structure for this phase consistent with the data is presented. The terminal solubility was measured, and a partial phase diagram is given. In addition, the precipitation of these nitrides from supersaturated solution is described. (9 figures, 17 references) (auth)

6346 HIGH-TEMPERATURE OXIDATION OF TUNGSTEN WIRES IN O_2–Ar MIXTURES. Harvey, F. J. (Westinghouse Research Labs., Pittsburgh). Met. Trans.; 4: No. 6, 1513-1517 (Jun 1973).

The rate of volatilization of tungsten wires in natural convection by high-temperature oxidation was measured in O_2–Ar mixtures containing between 20 and 150 ppM O_2 at 0.789 atm total pressure. At constant oxygen partial pressure the rate generally decreases with increasing temperature between 2450 and 3200 K. The magnitude of the rate ranges between 1.2×10^{-6} and 1.7×10^{-5} g/cm^2-s, depending on temperature and oxygen partial pressure. The oxidation reaction is gas-transport controlled as demonstrated by supplemental measurement in helium oxygen mixtures, by experiments in 0.395 atm of argon, and by comparison with previous measurements on surface-controlled oxidation of tungsten. The experimental results are in reasonable agreement with a volatile-oxide counter-diffusion model. (auth)

6347 THERMODYNAMIC PROPERTIES OF Nd–Zn ALLOYS. Chiotti, P.; Mason, J. T. (Ames Lab., IA). Met. Trans.; 4: No. 6, 1527-1531(Jun 1973).

Zinc vapor-pressure data obtained by the dewpoint method were used to calculate the thermodynamic properties of the compounds and liquid alloys of the Nd–Zn system. The standard free energy of formation in calories for the compounds according to the reaction $Nd(\alpha) + xZn(l) + NdZn_x(s)$ is given. The thermodynamic properties of the liquid alloys were obtained by graphical integration of the Gibbs–Duhem equation and are presented in tabular form. (auth)

6348 MICROSTRUCTURAL STABILITY OF THERMAL–MECHANICALLY PRETREATED TYPE 316 AUSTENITIC STAINLESS STEEL. Spruiell, J. E.; Scott, J. A.; Ary, C. S.; Hardin, R. L. (Univ. of Tennessee, Knoxville). Met. Trans.; 4: No. 6, 1533-1544(Jun 1973).

Studies of the microstructural stability of Type 316 austenitic stainless steel were performed for a wide range of thermal–mechanical pretreatments in the limited aging temperature range of 550 to 760°C. The pretreatments were selected in order to investigate the effects of varying solution treatment temperature, amount of cold reduction by rolling, initial grain size, and initial precipitate distribution. Large variations in both phase stability and recrystallization behavior can be effected by appropriate pretreatments. Cold work accelerates precipitation of $M_{23}C_6$ carbide and the intermetallic compounds (Laves, χ, and σ phases). Both the amount and kinetics of σ phase formation are especially enhanced by recrystallization occurring in the aging temperature range. It is suggested that this occurs due to ready σ nucleation at slowly moving (recrystallizing) grain boundaries together with enhanced growth rates due to diffusion along the boundary. Fine grain size enhances phase instability by providing additional nucleating sites and decreased diffusion paths for precipitate forming elements, but in the grain-size range studied (ASTM No. 3.5 to No. 13) the effect is not as significant as the effect of cold work, particularly when recrystallization occurs during the aging treatment. Fine grain size and pretreatments that precipitate the carbides prior to the final cold working step enhance recrystallization kinetics relative to solution-treated and cold-worked materials. This is apparently due to stabilization of the cold-worked substructure in the solution treated samples by precipitation of carbide and Laves phases on the dislocations and stacking faults. (4 tables, 14 figures, 33 references) (auth)

6349 SOLUBILITY AND THERMODYNAMIC PROPERTIES OF OXYGEN IN SOLID MOLYBDENUM. Srivastava, S. C. Stony Brook, NY; State Univ. of New York (1972). 72p. University Microfilms Order No. 73-12,079.

Thesis (Ph.D.).

Solid solubility of oxygen in molybdenum has been determined by equilibrating zone-refined molybdenum rods with a powder mixture of $Mo + MoO_2$ in evacuated and sealed molybdenum capsules. Oxygen content of the rods was determined by the inert gas fusion method. A least-square fit through the experimental points gives the terminal solubility as $\ln C(\text{ppM}) = 17.88 - 27{,}900/T$, with T in degrees K. This solubility equation was used to calculate partial molar enthalpy and excess partial molar entropy of oxygen in solid solution from the phase diagram by using the standard free energy of formation of equilibrium oxide phase MoO_2. The values obtained for these parameters are –13.6 kcal and –10.6 cal/deg, respectively, when ½ mole of oxygen is dissolved in solid solution in molybdenum. (Diss. Abstr. Int., B)

6350 INFLUENCE OF LOW CONCENTRATIONS OF GROUP VIII METALS OF THE STRUCTURE AND PROPERTIES OF CAST MOLYBDENUM. Ageev, N. V.; Bokaraeva, N. N.; Guts, Z. A.; Egoshina, S. G.; Ignatov, D. V.; Kantor, M. M.; Model, M. S.; Pichugin, V. F. (Inst. of Metallurgy, Moscow). Metallofizika; No. 43, 100-103(1972). (In Russian).

The effect of a few tenths of a percent of Fe, Co, and Ni on the properties of cast Mo was studied by measuring the lattice constants and microhardness of the alloys. The maximum lowering of the hardness was occasioned by 0.1 to 0.2% of the Group VIII metals. Lattice period changes were linear functions of the added metal concentrations. Photographs of the alloy samples made with an electron microscope are discussed. (KSW)

6351 EFFECT OF CARBON ON THE STRUCTURE AND PROPERTIES OF MOLYBDENUM. Zelenskii, G. K.; Borodich,

V. D.; Gogin, A. D.; Korontsevich, V. K.; Milovidov, S. N.; Fedorov, V. S.; Fil'kin, V. Ya. Metallofizika; No. 43, 124-131 (1972). (In Russian).

The properties and structure of Mo containing from 0.004 to 0.09% of C were investigated. An increase in the C content was accompanied by separation of Mo carbide, both within the matrix and at the grain boundaries and by increased brittleness of the Mo. The temperature of brittle transition was a function of the concentration of C. (KSW).

6352 EFFECT OF SELF DIFFUSION ON NMR LINEWIDTH IN BERYLLIUM. Chabre, Y.; Segransan, P. (Univ., Grenoble, France). Solid State Commun.; 12: No. 9, 815-817(1 May 1973).

NMR line-width and T_2 measurements in Be between 300 and 1200°K are presented. Adiabatic and nonadiabatic parts of the line width are dependent on temperature through the static quadrupolar interaction, and this precludes a simple deduction of the self-diffusion activation energy from c-w line-width measurements. Analysis of T_2 measurements using a pulse technique gives a value of 1.4 ± 0.1 eV for this energy. (auth)

6353 DETERMINATION OF BOUNDARIES OF MARGINAL SINGLE-PHASE DOMAINS OF THE Mo–Cu–Ni SYSTEM IN SOLID STATE. Kozlova, R. F.; Rabkin, V. B.; Blinova, N. V. Porosh. Met., Akad. Nauk Ukr. SSR; No. 2, 65-70(Feb 1973). (In Russian).

It was established that, in the ternary system Mo–Cu–Ni, there is a single-phase domain of copper and nickel solid solution in molybdenum with total content of dissolved components about 1.5 to 2%. The Cu–Ni side of the system is adjoined by a single-phase domain of the ternary solid solution Cu–Ni–Mo, molybdenum content which increases gradually with an increase in the nickel content from 1.5% by weight with Ni : Cu = 20 : 80 to 3% weight with Ni : Cu = 40 : 60. (auth)

6354 THERMO-EMF OF p- AND n-TYPE INDIUM ANTIMONIDE AT ROOM TEMPERATURE. Mirgalovskaya, M. S.; Raukhman, M. R.; Il'chenko, L. N.; Sorokina, N. G. (Inst. of Metallurgy, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 10, 1539-1542(Oct 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 10, 1751-1754(Oct 1972).

A method for measuring the thermo-emf used in rapid determination of the absolute values at 300°K on specimens 12 to 15 mm long, 3 to 5 mm wide, and 0.5 to 1.5 mm thick is described. The thermo-emfs of Zn- and Te-doped InSb specimens have been measured in a wide concentration range. The thermo-emfs of InSb specimens strongly doped with Te differ from those of specimens strongly doped to the same concentration with Se or S. Assuming that the conductivity zone is nonparabolic (Keune's model), the electron dispersion at 300°K was calculated. The calculated curves are compared with the experimental curves. (auth)

6355 DISTRIBUTION RATIOS OF TELLURIUM AND ZINC IN SOLID-SOLUTION ALLOYS GaSb–InSb. Sterl'nikova, I. A.; Mirgalovskaya, M. S.; Koval, S. P. (Inst. of Metallurgy, Moscow) Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 10, 1546-1549(Oct 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 10, 1758-1761(Oct 1972).

The concentration dependences of k_{eff} for Te and Zn in the solid-solution alloy GaSb–InSb (~9 mole % InSb) were investigated. It was found that, in the doping range from 3×10^{17} to 2×10^{19} atoms/cm^3, k_{eff} is equal to about 1.0, but decreases to 0.33 when the Zn concentration in the melt is increased to about 10^{20} atoms/cm^3; at concentrations from 8×10^{17} to 5×10^{19} atoms/cm^3, k_{eff} of tellurium is about 0.08, but on heavier doping it rises to 0.2. The k_{eff} of tellurium and zinc in solid solution alloys GaSB–InSb vs the InSb content of the melt was plotted. It was found that there is marked negative deviation of the experimental graphs from an additive straight line for this property. An interpretation of the observed phenomena is given. (auth)

6356 EFFECT OF STRUCTURAL FACTORS ON THE TRANSITION TEMPERATURE OF METALS WITH BCC LATTICE TO THE POINT OF BRITTLE FAILURE. Mil'man, Yu. V. (Inst. of Metal Physics, Kiev). Metallofizika; No. 43, 25-42(1972). (In Russian).

An analytical expression was obtained for the temperature of transition to brittle disintegration T_x, based on Cottrell's criteria of fragile breakdown and the temperature dependence of flow stresses in bcc transition metal lattices. Using this expression, experimental data on the effects of structural factors, deformation conditions, and alloying, on T_x were analyzed. Compositions of interest included the dispersed alloy Mo–0.8% ZrC, W–ThO_2, and Cr alloys. (68 references) (KSW)

6357 EQUILIBRIUM SEGREGATION AT GRAIN BOUNDARIES AND INTERCRYSTALLINE COLD BRITTLENESS OF SOLID SOLUTIONS. Glikman, E. E.; Bruver, R. E. (Moscow State Univ.). Metallofizika; No. 43, 42-63(1972). (In Russian).

Fundamental regularities with regard to intercrystalline low-temperature brittleness of metallic solid solutions and alloys have been previously associated with equilibrium segregation (internal adsorption) of impurities at grain boundaries. Available literature data formed the basis for this study and included such metals as Mo, Be, Cd, W, Ce, Re, V, and Nb. It was concluded that typical cases of low-temperature brittleness were not connected with such separation at grain boundaries. "Dangerous" impurities are listed, and "rational" alloying with "useful" impurities is discussed. (75 references) (KSW)

6358 ACTIVITY OF In IN LIQUID In–Sb ALLOYS. Chatterji, D.; Smith, J. V. (Aerospace Research Labs., Wright-Patterson Air Force Base, OH). J. Electrochem. Soc.; 120: No. 6, 770-772(Jun 1973).

Oxygen-concentration cells based on the electrolyte, $Zr_{0.85}Ca_{0.15}$-$O_{1.85}$, were successfully used to determine the In activity in liquid In–Sb alloys at 560 to 800°C. Only In-rich alloys could be studied. Results are in agreement with the data obtained by earlier workers who used halide-based concentration cells, and assumed presence of monovalent In ions in their electrolytes. The present investigation therefore serves not only as an independent source of In-activity data but also as an indirect evidence of correctness of the assumption regarding the oxidation state of In ions in In–halide melts. (auth)

6359 NORMAL MOMENTUM TRANSFER FOR GASES ON TUNGSTEN. Moskal, E. J. Toronto; Univ. of Toronto (1971). National Library of Canada, Ottawa.
Thesis (Ph. D.).

A high-energy molecular beam facility, utilizing a free-jet expansion, was used to obtain a near monoenergetic beam of neutral-helium and argon particles. The molecular flux was obtained by stagnating the beam in a chamber upon which was mounted a mass spectrometer. The velocities of the beam particles were obtained from a metastable time-of-flight velocity analyzer. In this way, the incoming momentum of the beam was characterized. The argon atoms, in particular, had an energy that could be varied from 0.06 to 0.53 eV. This beam of neutral atoms impinged on a single crystal tungsten target, with the (100) face exposed to the beam. The target was mounted on a torsion balance. The rotation of this torsion balance was monitored by an optical lever, and the reading was converted to a measurement of the momentum exchange between the beam and the target. The tungsten target was flashed to a temperature in excess of 2000°C before every "clean" run, and the vacuum levels in the final chamber were typically between 5×10^{-10} to 1×10^{-9} torr. The momentum exchange for the helium gas–(100) tungsten surface, and the argon gas–(100) tungsten surface combination, was obtained over approximately a decade of incoming energy (for the argon gas) at angles of incidence of 0, 30, and 41°, on both "clean" and "dirty" (gas covered) surfaces. The results exhibited a significant variation in momentum transfer between the data obtained for the "clean" and "dirty" surfaces. The values of normal momentum accommodation coefficient for the clean surface were found to be lower than the values previously reported. (Diss. Abstr. Int., B)

6360 TRACE PHASE ANALYSIS AS MEANS OF INVESTIGATION OF HETEROGENEOUS IMPURITY CONTAMINATION IN POWDER METALLURGY. Lassner, E.; Benesovsky, F. (Metallwerk Plansee, Reutte/Tyrol, Austria). Planseeber. Pulvermet.; 20: No. 3, 171-184(Sep 1972). (in German).

Heterogeneous impurities in powder metallurgical raw materials cause various severe defects in materials. Owing to the temperature and time dependence of the diffusion processes, the impurities are distributed only over small regions in which their concentration is relatively high. Using two special examples of refractory metals it is shown that the conventional analytical techniques for the detection of such heterogeneous impurities in raw materials are inadequate and should be replaced by trace phase analysis. (auth)

6361 ELECTRIC AND THERMAL CONDUCTIVITIES, ELASTIC PROPERTIES, AND BEND RESISTANCE OF POROUS TUNGSTEN IN EACH DOMAIN OF POROSITY. Francois, D.; Terraz, C.; Meyer, R.; Pastor, H. (CEA, Montrouge, France). Planseeber, Pulvermet.; 20: No. 3, 185-202(Sep 1972). (In French).

6362 ELASTIC PROPERTIES OF MOLYBDENUM. Reiter, W.; Benesovsky. F. (Metallwerk Plansee, Reutte/Tyrol, Austria).

Planseeber. Pulvermet.; 20: No. 3, 203-218(Sep 1972). (In German).

The Young's modulus and Poisson ratio of sintered molybdenum with different deformation history (32, 58, and 70% deformation) were measured as a function of annealing temperature (800 to 1800°C) and annealing time (1 to 15 hours) under compression, using radially arranged strain gages. The modulus is reduced by work hardening as well as through porosity. The modulus defect increases with the degree of previous deformation. On the other hand, the grain size which is a function of the annealing parameters, has no noticeable effect on the elastic properties. An attempt is made to correlate the healing of the modulus defect with dislocation blocking and dislocation rearrangement and their mutual extinction. However, neither of the two models of the recovery of the elastic constants is adequate to account completely for the results. The Poisson ratio varies comparatively less than the Young modulus and is reduced by porosity as well as by work hardening. The results are correlated with literature data on the elastic constants of single crystals and polycrystals. (auth)

Radiation Effects

Refer also to abstracts 5433, 7189, 7320, 7330, 7342, and 7371.

6363 (BNL−50336, pp 131-149) INELASTIC INTERACTION OF ELECTRONS WITH SOLIDS (EXCITATION OF PLASMONS). Raether, H. (Univ., Hamburg). Feb 1973.

In interaction of energetic charged particles with solids.

The inelastic interactions of electron beams with electrons of the crystal (collective plasmon excitations and excitation of single electrons with resulting band transitions) are observed by measuring the energy loss of the electron beam. Excitation of volume and surface plasmons is considered in turn. Excitation by photons is also considered. Finally, excitation of band transitions and radiation losses are discussed. (8 figures, 19 references) (DLC)

6364 (BNL−50336, pp 271-304) RADIATION EFFECTS IN BINARY SYSTEMS. Damask, A. C. (Queens Coll., New York). Feb 1973.

In interaction of energetic charged particles with solids.

A brief review is given of a simplified version of kinetic analysis for interstitial and substitutional solid solutions, and possible radiation effects in alloys are considered. These effects include disordering, breakup of precipitate particles, enhanced nucleation, retarded diffusion, and enhanced diffusion. Data from the literature are presented for Cu_3Au, Fe−C, and α-brass. (21 figures, 19 references) (DLC)

6365 (BNL−50336, pp 331-403) PARTICLE CHANNELING PRINCIPLES AND APPLICATIONS: A BRIEF PERSONAL REVIEW. Gibson, W. M. (Bell Telephone Labs., Inc., Murray Hill, NJ). Feb 1973.

In interaction of energetic charged particles with solids.

In this review, emphasis is placed on selected unsolved problems and recent developments. The single string continuum theory and its limitations are discussed. Monte Carlo techniques are also discussed. Critical angle, minimum yield, and shoulders are among the features discussed. Two applications (impurity ion location-flux peaking and nuclear lifetime determination) are considered. (37 figures, 149 references) (DLC)

6366 (CEA-R−4386) LENGTH CHANGE IN PLUTONIUM AND IN SOME COMPOUNDS BY SELF-IRRADIATION AT 4.2°K. Jacquemin, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Apr 1973. 96p. (In French). Dep. NTIS (U. S. Sales Only) $7.00.

Thesis. Submitted to Faculte des Sciences, Univ. of Paris, Orsay, France.

Length changes due to self-irradiation at 4.2°K in α, β, and δ plutonium as well as in PuN, PuC, and PuO_2 were measured. Two types of defects were found in these three compounds; the first type observable only at low temperature. In α plutonium results of experiments at 1.55 and 3.75°K show that there is already some annealing at 4.2°K. In the β and δ phases, the self-irradiation at 4.2°K induces a contraction. (auth)

6367 (HEDL-SA-508) EFFECT OF IRRADIATION TEMPERATURE ON VOID FORMATION IN COLD-WORKED TYPE-316 STAINLESS STEEL. Brager, H. R.; Straalsund, J. L. (Hanford Engineering Development Lab., Richland, Wash.). Dec 1972. Contract AT(45-1)-2170. 5p. (CONF-730611-2). Dep. NTIS $3.00.

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973).

Results of radiation studies are presented showing that the irradiation temperature dependence of cold-worked Type-316 stainless steel is different from that of the solution-treated steel and from that of the previously reported empirical swelling equation for cold-worked steel. This difference in temperature dependence may be important in the analysis of the distortion of fast-reactor-core components. The difference in the temperature dependence of void formation is related to the thermal instability, or recovery kinetics, of the cold-worked microstructure. In this regard, the swelling of cold-worked stainless steel due to high-energy-particle bombardment must be critically evaluated as to its use for simulating fast-reactor-induced void formation in cold-worked materials. (auth)

6368 (SLA−73-230) ION IMPLANTATION DEPOSITION OF ENERGY INTO ELECTRONIC PROCESSES IN SILICON AND GERMANIUM TARGETS. Brice, D. K. (Sandia Labs., Albuquerque, N. Mex.). Mar 1973. 46p. Dep. NTIS $4.50.

The first calculations of the depth distribution of energy into ionization, including the effects of elastic atom−atom scattering, were made for heavy ions incident on silicon and germanium targets. Specific ions considered ranged in mass from ^7Li to ^{51}V, and the energy range considered was 40 to 400 keV. The resultant depth distributions are all quite similar, and because of this similarity interpolation between properly normalized curves proves to be quite accurate. Normalized curves are tabulated which, with the projected range of the ions, R_p, and the total energy into ionization, E_I, will allow construction of the depth distribution of energy into an ionization curve for any ion or incident energy falling within the range of those considered here. In addition, the interpolation process can be used to construct the distributions for other targets. Values of E_I as a function of incident energy are also given to aid in the process. (auth)

6369 MAGNETIC AFTEREFFECT IN ELECTRON-IRRADIATED NICKEL. Knoell, H. (Kernforschungsanlage, Juelich, Ger.). (1972). vp. (In German).

From discussion meeting 1972: magnetic aftereffects; Weinheim, Germany (9 Oct 1972).

A report is given on aftereffect measurements on Ni within the temperature range of stage I (10 to 100 K) after electron irradiation at 4.5 K. Simultaneously, with the aftereffect, the annealing behavior of the residual electric resistance was measured. It is stated that the aftereffect at 55 K is to be assigned to the stage I (D + E), and all aftereffect phenomena within the range of stage I recover again directly during the appearance. (tr-auth)

6370 F^+ CENTER IN REACTOR-IRRADIATED ALUMINUM OXIDE. La, S. Y.; Bartram, R. H.; Cox, R. T. (Paterson State Coll., Wayne, N. J.). J. Phys. Chem. Solids; 34: No. 6, 1079-1086(Jun 1973).

A point-ion calculation was performed for the F^+ center in α-Al_2O_3 (one electron in an O^{2-} vacancy). Optical transitions are predicted at 2.26, 3.39, and 5.15 eV. Contact hyperfine interactions with the two nearest pairs of Al^{3+} ions are calculated to be 151 and 39 G. Single crystals of α-Al_2O_3 were reactor-irradiated up to doses of 10^{20} fast neutrons per cm^2, and studied by electron spin resonance (ESR). A broad ESR spectrum with 13 resolved components at $g = 2.0029 \pm 0.0005$ was interpreted as the interaction of an unpaired electron with two pairs of Al^{3+} nuclei with hyperfine constants of 49.2 and 13.5 G. These values are in the same ratio as the values calculated for the F^+ center, to which this ESR spectrum is attributed. The discrepancy of a factor of three is typical of point-ion calculations. The optical absorption spectrum for heavily-irradiated samples is not available for comparison with calculated transition energies. (auth)

6371 CHANGE OF LATTICE PARAMETERS AND RESIDUAL RESISTANCE IN NIOBIUM AFTER NEUTRON IRRADIATION AT LOW TEMPERATURES. Boening, K.; Doenitz, W.; Hertz, W.; Peisl, H.; Waidelich, W. (Technische Univ., Darmstadt, Ger.) (1972). 7p. (In German).

From spring meeting of the German Physiology Society; Freudenstadt, Germany (10 Apr 1972).

Samples of bcc Nb (monocrystals and wire) were irradiated with fast neutrons in the Munich Research Reactor at 4.6°K, and the resulting changes of lattice parameters and residual resistance were measured either directly or by x-ray diffraction (Bragg method with Cu−Kα line). The samples were irradiated with doses of 2.2 to 3.5×10^{18} n/cm^2 and used for measurements of various isochronous tempering programs. A comparison with preliminary data on stored energy is also done with respect to the volume behavior. (GF)

6372 RADIATION EFFECTS ON THE THERMAL AND PHOTOELECTRIC WORK FUNCTION OF InSb. Lehr, S. (Technische Univ., Darmstadt, Ger.). (1972). 4p. (In German).

From spring meeting of the German Physiology Society; Freudenstadt, Germany (10 Apr 1972).

Measurements were performed in high vacuum using 25- to 100-keV electron and 1.7- to 6.2-eV photon irradiation at liquid N_2 temperature. The work function was determined via the contact potential according to the Kelvin method, using Au as reference electrode. (GF)

6373 SPECIAL STEELS IN NUCLEAR ENGINEERING. Rajakovics, G.; Kulmburg, A.; Weingerl, H.; Ploeckinger, E. Berg–Huettenmaenn. Monatsh.; 117: No. 5, 159-167(May 1972). (In German).

The specific problems concerned with nuclear reactor construction are discussed, and the property requirements of steels for nuclear-engineering applications are outlined. The steels developed for nuclear engineering must resist radiation damage, high temperature embrittlement, pore formation and, (in future reactors) corrosion by the cooling media, e.g. Na. As an example of the problems encountered in nuclear-engineering materials development, the corrosion of Types X8 CrNiMoVNB 16 13 and X8 CrNiMoVNb 16 16 steel specimens immersed in a Na loop is discussed. (Metals Abstr.)

6374 PROTON BEAMS TO STUDY CRYSTALLINE MATERIALS. Nelson, R. S. (Atomic Energy Research Establishment, Harwell, Eng.). pp 183-202 of Techniques Involving Extreme Environment, Nondestructive Techniques, Computer Methods in Metals Research, and Data Analysis. Bunshah, R. F. (ed.). New York; John Wiley and Sons, Inc. (1972).

An outline is presented of the basic concepts concerning the crystallographic effects (channeling) that occur when a beam of protons or charged particles interacts with a crystal lattice. The use of these effects to study both the crystal structure and the atomic positions of impurity atoms within crystals is illustrated. (15 figures, 18 references) (DLC)

6375 PROBLEMS CONCERNING STEEL USED IN WATER-COOLED REACTORS. Cerjak, H. Berg- Huettenmaenn. Monatsh.; 117: No. 5, 135-149(May 1972). (In German).

Low-alloy fine-grained structural and Cr–Ni alloy steels are used in water-cooled nuclear reactors. Such steels are required to have good properties with regard to radiation behavior, corrosion resistance and susceptibility to brittle fracture. The effects of neutron bombardment on structural steels for reactor plant are outlined and the problems encountered during the fabrication, particularly joint welding and cladding, of reactor steels, are discussed. Toughness and brittleness aspects are examined and techniques for testing reactor steel from the point of view of fracture safety are mentioned. (Metals Abstr.)

6376 EFFECT OF NEUTRON RADIATION ON FATIGUE BEHAVIOR. Kangilaski, M. (General Electric Co., San Jose, CA). pp 569-574 of Corrosion Fatigue: Chemistry, Mechanics, and Microstructure. Devereux, O. F. (ed.). Houston, TX; National Association of Corrosion Engineers (1972).

From international conference on corrosion fatigue: chemistry, mechanics and microstructure; Storrs, Connecticut, USA (14 Jun 1971). See CONF-710603-.

Literature data are reviewed for stainless steels, A-302B steel, and Mg. It is concluded that neutron irradiation affects the fatigue life of metals as follows: (1) At low strains (or stresses), the fatigue life at low temperatures is enhanced by neutron irradiation. (2) The enhancement of fatigue life for irradiated specimens is brought about by reducing the fraction of plastic strain for a given total strain. At high strains, irradiation reduces the ductility of the metal and; consequently, the fatigue life is also reduced. (3) Irradiation does not increase the elevated temperature strength and drastically reduces the elevated temperature ductility. Consequently, the elevated temperature fatigue life is significantly reduced by irradiation. (4) Both room temperature and elevated temperature fatigue of irradiated stainless steel can be predicted from tensile test data obtained from irradiated specimens. (12 figures, 17 references) (DLC)

6377 LATTICE PARAMETER MEASUREMENTS IN PLATINUM AFTER NEUTRON IRRADIATION AT 4.6 K. Doenitz, W. (Technische Univ., Munich); Vogl, G.; Hertz, W.; Peisl, H.; Waidelich, W. (1972). 4p. (In German).

From spring meeting of the German Physiology Society; Freudenstadt, Germany (10 Apr 1972).

Combined measurements of changes of residual resistance and lattice parameters were carried out for zone-refined wire-shaped Pt monocrystals. The samples were irradiated in the Munich Research Reactor (1.3 to 2.4 × 10^{18} n/cm^2) at 4.6°K. The lattice parameters are determined by conventional x-ray diffractometry (Bragg method) after an appropriate decay time for the samples. By means of isochronous tempering programs, the line shift and asymmetric line broadening were recorded. The specific volume contribution of Frenkel pairs were calculated. (GE)

6378 EFFECT OF GAMMA IRRADIATION ON ELECTRICAL PROPERTIES OF A REAL GERMANIUM SURFACE. Lysenko, V. S.; Litovchenko, V. G.; Kornyushin, S. I.; Chernopiskii, V. P. (Inst. of Semiconductors, Kiev). Poluprov. Tekh. Mikroelektron.; No. 7, 47-51(1972). (In Russian).

Some results are given of a study of radiation defects induced by exposure to gamma quanta on the surface and in the space-charge region in germanium. Thin specimens of N-type (ρ = 20, 43, and 50 Ω · cm) and P-type (ρ = 30 Ω · cm) were studied. The results of the research showed an appreciable increase in the rate of surface recombination, especially in the region of positive potentials, with a new recombination level on curves for surface recombination rate as a function of initial potential in this region. Specimens with an elevated oxygen content showed an increase in the density of fast shielding states throughout the potential range, whereas oxygen-free specimens showed practically no change in the concentration of such states. The initial potential was shifted toward the N side after exposure in all specimens. The maximum displacement was accompanied by a reduction in the density of "slow" states. The stability of the new centers was shown by the fact that the surface characteristics of irradiated specimens were not altered by exposure to the atmosphere for two months. Very brief treatment in hydrogen peroxide (about 4 s) almost completely restored the surface potential to the values observed in specimens before irradiation. This indicates that the potential displacement observed is due to alteration of the chemical structure of the surface oxide phase. (JPRS)

Other Materials

Refer also to abstracts 5305, 5605, 5867, 5885, 6317, 6368, 6374, 6709, 7199, and 7295.

6379 (BNL–50336, pp 214-224) DEFECT FORMATION BY LOW-ENERGY IONIZING RADIATION. Dienes, G. J. (Brookhaven National Lab., Upton, NY). Feb 1973.

In interaction of energetic charged particles with solids.

Ionizing radiation of energy too low to produce observable effects in metals can produce defects in insulators; vacancies and ion displacement are produced in alkali halides near 4°K as long as the photon energy is higher than the band gap. The nature of some of the simple color centers (V_K, F, H) is described, and the mechanism of defect formation is discussed. The mechanism results in the simultaneous formation of H and F centers following V_K–electron recombination. The problem of formation of α and I centers is considered. (7 figures, 14 references) (DLC)

6380 (CONF-730425-1) MULTIAXIAL CREEP IN CONCRETE. McDonald, J. E. (Army Engineer Waterways Experiment Station, Vicksburg, Miss.). 1973. Contract AT(40-1) 3636. 22p. Dep. NTIS $3.25.

From the effects of environment and time on the mechanical behavior of concrete symposium; San Francisco, California, USA (9 Apr 1973).

For Oak Ridge National Lab., TN.

Results of an investigation concerned with creep in prestressed concrete reactor vessels are summarized. The investigation was concerned with one concrete strength (6000 psi at 28 days), three aggregate types (chert, limestone, and graywacke), one cement (type II), two moisture conditions (as-cast and air-dried), two testing temperatures (73 and 150°F), and four types of loading (uniaxial, hydrostatic, biaxial, and triaxial). Most of the test results are presented graphically. (JRD)

6381 (DP-Report-646) IRRADIATION DATA ON GILSOCARBON GRAPHITES FOR HIGH TEMPERATURE NUCLEAR REACTORS. Blackstone, R.; Graham, L. W.; Everett, M. R.; Delle, W. (Atomic Energy Establishment, Winfrith (England)). Apr 1969. 56p. (CONF-690620-6). Dep. NTIS (U. S. Sales Only) $5.00.

From symposium on radiation damage in solids and reactor materials; Vienna, Austria (2 Jun 1969).

Reasons for the initial selection of Gilsocarbon-based graphite for use in high-temperature reactors are discussed. Data are presented on the dimensional changes, the changes in the technologically most important properties, and on creep, induced by irradiation in the temperature range 600 to 1200°C. A range of fast neutron doses approaching 5 × 10^{21} n/cm^{-2} is covered. (auth)

6382 (DP-Report-665) HIGH-TEMPERATURE RADIATION-INDUCED CREEP IN GRAPHITE. Dragon Project. Blackstone, R.; Graham, L. W.; Everett, M. R. (Atomic Energy Establishment, Winfrith (England)). Oct 1969. 50p. (CONF-690627-3). Dep. NTIS (U.S. Sales Only) $4.50.

From 9th conference on carbon; Boston, Massachusetts, USA (16 Jun 1969).

The irradiation creep of graphite has been determined at 600, 800, 900, and 1200°C by successive irradiations in the High Flux Reactor Petten, for specially designed assemblies in which two or more graphites having differing shrinkage rates are used in opposition to provide tensile or compressive stress in a specimen. The experimental technique is described and the results are compared with the predicted calculated behavior of the assemblies. Tensile creep strain in excess of 2% has been obtained. Attempts are made to correlate the observed creep constants with other physical properties. (auth)

6383 (DP-Report–699) GRAPHITE MATERIALS DATA FOR HIGH-TEMPERATURE NUCLEAR REACTORS. Dragon Project. Everett, M. R.; Blackstone, R.; Graham, L. W.; Manzel, R. (Atomic Energy Establishment, Winfrith (England)). Dec 1969. 36p. (CONF-700407–3). Dep. NTIS (U. S. Sales Only) $4.00.

From third international conference on industrial carbon and graphite; London, UK (14 Apr 1970).

The design of a high-temperature helium-cooled reactor requires extensive irradiation property change data for graphite materials used in the core. Data are surveyed on the dimensional and physical property changes on irradiation at temperatures in the range 600 to 1200°C at neutron doses of $\sim 4 \times 10^{21}$ n/cm^{-2} (Ni-dose Dido equivalent) on pyrolytic carbon used for coated-particle fuels, fuel compacts made by pressing coated particles in resin-bonded graphite powder matrices, and nuclear grade graphites suitable for fuel tubes and moderator blocks. Aspects of the thermal performance and stress problems in fuel elements are discussed where these are significantly influenced by graphite materials selection and design. (auth)

6384 (RDT-M-12-6-T(3-73)) MINERAL FIBER THERMAL INSULATION, HIGH-TEMPERATURE, RIGID, FLEXIBLE, AND LOOSE FILL (ASTM C612 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Mar 1973. 10p. RSO.

A standard prescribing requirements for mineral fiber thermal insulation, high-temperature, rigid, flexible, and loose fill (ASTM C612 with additional requirements) for nuclear and associated applications is presented. (JRD)

6385 (SLA-73-499) DYNAMIC FRACTURE TOUGHNESS OF CARBON–CARBON COMPOSITES. Hoover, W. R.; Guess, T. R. (Sandia Labs., Albuquerque, N. Mex.). Apr 1973. 26p. Dep. NTIS $3.50.

The dynamic fracture toughness of two types of carbon–carbon composites (filament wound and felt substrate) and ATJ-S graphite was determined from instrumented Charpy impact tests. The resistance to crack initiation from a pre-existing flaw (notch) was examined by investigating the dynamic fracture toughness, K_D, a linear elastic fracture mechanics parameter. The resistance to crack initiation and propagation was determined using the dynamic work-of-fracture parameter, γ_{fD}. Testing was conducted over a range of impact velocities (4.0 to 202.8 in/s), and the parameters K_D and γ_{fD} were found to be strongly sensitive to impact velocity for all three materials. As expected, the dynamic fracture toughness of the highly anisotropic filament wound carbon–carbon composite was dependent on filament orientation. (auth)

6386 (Y-1857) PRECURSOR CARBON AND MOLDED GRAPHITE STUDIES. NERVA Fuel Element Development Program Summary Report, July 1966–June 1972. Overholser, L. G. (comp.) (Oak Ridge Y-12 Plant, Tenn. (USA)). 6 Apr 1973. Contract W-7405-eng-26. 92p. Dep. NTIS $3.00.

Isotruxene, truxene, cinnamylideneindene, acenaphthalene, and mixtures of some of these carbon precursors were carbonized by heating in a nitrogen atmosphere at ambient pressure to temperatures of 550 to 900°C, or by pressure cooking in a gas autoclave at 700°C and 15,000 psi of argon. Samples of these carbons fired to 2,800°C and commercial carbons obtained from various graphite manufacturers were characterized by x-ray diffraction and metallographic methods. Many of the carbons were used as fillers in the fabrication of graphites using hot-pressing techniques (pressing temperatures of 500 to 2,800°C and pressures of 1,600 to 2,400 psi). Isotruxene, cinnamylideneindene, and coal-tar or petroleum pitches were used as binders in the experimental fabrication of graphites. Properties of these graphites (along with several standard grades obtained from commercial suppliers) were determined, and included bulk and liquid densities, pore spectra, flexural strength, modulus of elasticity, strain at rupture, electrical resistivity, Bacon anisotropy factor, and coefficient of thermal expansion. Microstructures were examined by metallographic methods. Thermal shock resistance of a number of the graphites was determined experimentally and also calculated from their appropriate physical properties. (auth)

6387 (Y-1879) CALCULATED POWDER X-RAY DIFFRACTION DATA FOR BORON. Holcombe, C. E. Jr.; Coffey, A. L. Jr. (Oak Ridge Y-12 Plant, Tenn. (USA)). 25 May 1973. Contract W-7405-eng-26. 16p. Dep. NTIS $4.00.

A literature review was made of the crystallographic data and a study was made of computer-simulated powder x-ray-diffraction data and of the solid-solution formation for boron polymorphs. (4 tables, 19 references) (auth)

6388 ATTEMPT TO DEMONSTRATE THE EXISTENCE OF CHEMICALLY BOUND NEUTRONS. Fried, S.; Friedman, A.; Wahlgren, M. (Argonne National Lab., Ill.). Radiochim. Acta; 18: No. 2, 65-67(1972).

T. J. Grant and J. W. Cobble (Phys. Rev. Lett. 23: 741(1969)) reported the delayed emission of neutrons from a cooled (4°K) crystal of LiF that contained trapped electrons and that had been exposed to the neutron beam from a Cockcroft–Walton generator. When the irradiated crystal was removed from the liquid-helium cooling bath and allowed to warm up in a neutron counter, approximately two neutrons could be observed per experiment. These neutrons were emitted at a rate corresponding to a half-time in LiF of approximately 30 sec. These experiments suggested that the neutrons from a Cockcroft Walton generator were somehow bound in the LiF crystal at low temperatures and were released as the crystal became warm. Attempts were made to duplicate these experiments using conditions as nearly identical as possible, even to the extent of using a LiF crystal supplied by Grant and Cobble. No effect such as they describe could be observed. (auth)

6389 COLOR CENTERS IN γ-IRRADIATED RUBY WITH A VANADIUM IMPURITY. Sudorov, E. A.; Volynets, F. K.; Korolev, E. A. Zh. Prikl. Spektrosk.; 17: No. 5, 781-785(Nov 1972). (In Russian).

The effect of γ-radiation on Verneilevsk ruby and corundum with V impurity was investigated. The V demonstrated competing action in the formation of color centers in the ruby. The absence of general absorption bands in ruby and corundum with V was evidence that all bands were associated with an activator ion or its environment. Thermal transfer of charge between activators was noted in crystals of ruby with admixed V. (tr-auth)

6390 INFLUENCE OF PENETRATING IONIZING RADIATION ON THE CURING OF GROUTS AND CEMENT MORTARS. Nowakowski, B. (Polytechnic School, Poznan, Poland). Bldg. Sci.; 7: No. 4, 271-275(Dec 1972).

Investigations were made of cement grout and mortar exposed to the influence of hard ionizing radiation during setting, i.e. during a physical and chemical reconstruction of reactant lasting a few hours. The interference of penetrating ionizing radiation with the process of setting of cement has been found in the form of increased compressive and tensile strength, especially at the beginning of the hardening period. It has been ascertained that radiation influences the process of accelerating the hardening of cement mortars and grout. The data obtained show that radiation doses have virtually no influence upon the stated changes in the strength of grout. (JCW)

6391 ADMIXTURES OF IRRADIATED NUCLEI OF CRYSTALS AND THEIR INFLUENCE UPON THE HARDENING OF PLAIN CEMENT. Nowakowski, B. (Polytechnic School, Poznan, Poland). Bldg. Sci.; 7: No. 4, 277-285(Dec 1972).

Laboratory researches on and theoretical considerations of the influence of simple crystal nuclei and irradiated ones by ionizing penetrating radiation on various characteristics of cement mortars are discussed. Investigations of nucleation permitted a deeper explanation of the mechanism of radiation influence on acceleration of cement mortar hardening. (auth)

6392 BACKSCATTERING ENERGY SPECTRA NEAR THE CRITICAL ANGLE FOR PROTON CHANNELING. Sone, K. (Kyoto Univ., Uji, Japan); Fukuzawa, F. Mem. Fac. Eng., Kyoto Univ.; 34: No. 3, 315-324(Jul 1972).

Backscattering energy spectra of 1.0- and 1.5-MeV protons from Si single crystals were studied. At the shoulder of the dip-shoulder pattern of the scattering yield around $\{110\}$ channeling direction, the energy spectrum shows a conspicuous hump in the high-energy part. A simple model is proposed for the origin of this hump. (auth)

6393 TRANSMISSION OF FAST PROTONS THROUGH Si SINGLE CRYSTALS. Sone, K. (Kyoto Univ., Uji, Japan); Fukuzawa, F. Mem. Fac. Eng., Kyoto Univ.; 34: No. 3, 325-332(Jul 1972).

Transmission of 3.0-MeV protons through Si single crystal foil was studied. From the energy spectra of transmitted protons, stopping powers of Si along $\langle 111 \rangle$ axis and $\{110\}$ plane were found to be 0.54 and 0.65 times that of random direction, respectively.

Photographs of the transmission patterns observed on a ZnS screen are shown, and some interesting features are pointed out. (auth)

6394 HIGH-VOLTAGE ELECTRON TRANSMISSION MICROSCOPY OF PYROLYTIC SILICON CARBIDE COATINGS FROM NUCLEAR FUEL PARTICLES. Hudson, B.; Sheldon, B. E. (Atomic Energy Research Establishment, Harwell, Eng.). J. Microscopy; 97: No. 1-2, 113-119(Jan 1973).

One design concept for a gas-cooled fast-reactor fuel element utilizes directly cooled coated fuel particles. The fission-product retention barrier is a pyrolytic SiC layer approximately 50-μ thick and 1-mm diameter. Knowledge of the structure of this material and its irradiation performance after high neutron doses is vital to the success of such reactors. Specimens oriented both parallel and perpendicular to the radius can be prepared from the shells by ion-beam sputtering. The defect structure and preferred orientation of the coatings is investigated. The high-voltage electron beam is utilized to measure the atomic displacement energy and to simulate fast-neutron damage at temperatures relevant to reactor conditions. (auth)

6395 INVESTIGATION OF THE MAGNETIC PROPERTIES OF SINGLE CRYSTALS OF THE URANIUM COMPOUNDS U_3P_4 AND U_3As_4 IN STRONG FIELDS. Belov, K. P.; Genke, Z.; Dmitrievskii, A. S.; Levitin, R. Z.; Tshebyatovski, V. (Moscow State Univ.). Zh. Eskp. Teor. Fiz.; 64: No. 4, 1351-1355(Apr 1973). (In Russian).

Measurements were carried out of the magnetization of U_3P_4 and U_3As_4 single crystals in stationary magnetic fields up to 12 kOe and pulsed magnetic fields up to 300 kOe. It is shown that the compounds are highly anisotropic. Thus, field strengths of the order of 10^5 Oe are insufficient for magnetic saturation along the difficult magnetization directions (axes of the [100] type). The results are in agreement with the model of a noncollinear magnetic structure of U_3P_4 and U_3As_4. (auth)

6396 SPECTROSCOPIC PROPERTIES OF URANYL SULFATES WITH NEUTRAL LIGANDS. Shchelokov, R. N.; Krasilov, Yu. I.; Karasev, V. E.; Orlova, I. M. (Inst. of General and Inorganic Chemistry, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 11, 1726-1732(Nov 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 11, 1963-1970(Nov 1972).

The spectra and decay kinetics of luminescence of crystalline uranyl sulfates with neutral ligands were investigated. From an analysis of the frequencies and intensities of vibration of the uranyl ion and ligands, the structure of the coordination sphere of the uranyl group and the nature of the donor—acceptor uranyl—ligand bonds was discussed. The decay kinetics of the luminescence with temperature was studied in connection with the rate of the nonradiative process, resulting from interaction of high-frequency stretching and deformation vibrations of neutral ligands with the electron shell of the uranyl. (auth)

6397 EFFECT OF EXCITING RADIATION ON THE THERMAL GLOW OF NaCl : Sr. Joshi, R. V.; Kekan, N. L. (Maharaja Sayajirao Univ., Baroda, India). J. Phys., D (London); 6: No. 7, 888-890(1 May 1973).

Thermal glow curves for NaCl : Sr crystals irradiated with either ultraviolet or x-ray radiation were investigated over the temperature range from room temperature to 500 K. It is observed that the shape of the glow curve depends markedly on the energy of the exciting radiation. The Crawford—Nelson (Crawford, J. H. and Nelson, C. M., Phys. Rev. Lett., 5: 314-5 (1960)) mechanism is shown to have important implications for the hypothesis advanced to explain the x-ray induced thermoluminescence. (auth)

6398 RADIATION-INDUCED AC CONDUCTIVITY, THERMOSTIMULATED AC RESPONSE, AND LUMINESCENCE IN POWDERED ZnS-TYPE PHOSPHORS. Silverman, A. (New York Univ., NY); Kallmann, H.; Kramer, B. Phys. Status Solidi (a); 16: No. 2, 401-411(16 Apr 1973).

The ac conductivity induced during x-ray excitation and thermostimulation after excitation, as well as the fluorescent emission and thermoluminescence (glow) were investigated for different phosphors of the ZnS type over various temperature ranges. Very little correspondence between the conductivity and fluorescence was found at different temperatures during excitation; however, a strong correlation was observed between the ac conductivity during excitation, the thermostimulated conductivity, and the glow. At temperatures where the thermostimulated response was low, the ac response during excitation was also low. This is explained by a strong contribution to the ac response by electrons evaporating from traps into the conductivity band during the "field-on" period and being swept to the grain surfaces. Thus the ac response under excitation depends not only on the density of free electrons but also on the probability with which charges evaporate from traps. Since this depends on temperature, the ac response during excitation displays a strong temperature dependence. The observation that the dissipation factor maximum generally falls below the theoretical value is attributed to diffusion effects. (auth)

6399 RADIATION DAMAGE AND DEFECTS IN SEMICONDUCTORS. Proceedings of the International Conference Held at Reading, England, July 19—21, 1972. Conference Series Number 16. London; Institute of Physics (1973). 463p. (CONF-720713-).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972).

Fifty four papers were presented in sections entitled: defect production processes, highly disordered materials, observation of damage in the electron microscope, defect complexes and interactions, theoretical aspects of defects, radiation damage in silicon, radiation damage in germanium, radiation damage in III—V compounds (GaAs, GaP, InAs, InP), radiation damage in tellurium and II—VI compounds (CdTe), recent techniques of defect characterization. A separate abstract was prepared for each paper. (UK)

For abstracts of individual papers see: 5819, 6171, and 6400—6451.

6400 MECHANISM OF DEFECT PRODUCTION. Corbett, W. J.; Bourgoin, J. C.; Weigel, C. (State Univ. of New York, Albany). pp. 1-16 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Recent theoretical work on the configuration of the interstitial argues that the self-interstitial in diamond and silicon is an interstitialcy configuration rather than the tetrahedral or hexagonal configuration. It is argued here that these results imply a theoretical estimate of the adiabatic displacement energy which is about one half earlier estimates, which it is also argued is in better accord with experiment. The interatomic potential in a covalent semiconductor is discussed and the prospects for dynamic damage calculations in these materials considered. Calculations are presented on diamond and on silicon which suggest that the Frenkel pair are created as charged defects, for example, I^+ and V^-, giving rise to a coulombic contribution to the displacement energy. The coulombic term is isotropic as is, to first order, the static lattice displacement energy, in agreement with the experiments of Brown and Augustyniak (J. Appl. Phys., 30: 1300-9(1959)). Recent work on ionization-enhanced diffusion (IED) mechanisms is briefly surveyed and it is noted that IED can markedly affect the type of defects observed; for example, these mechanisms can account for the athermal, long-range motion observed in low temperature damage in Si and Ge, as well as anomalous effects in more ionic systems and in ion implantation. It is argued that IED may also be a factor in the so-called ionization damage in semiconductors. (auth)

6401 ROLE OF GROUP V IMPURITIES IN FORMATION OF DEFECTS IN GERMANIUM UNDER γ IRRADIATION. Emtzev, V. V.; Mashovetz, T. V.; Ryvkin, S. M. (Ioffe Inst. of Physics and Tech., Leningrad). pp. 17-25 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

A loss of the shallow donor states was experimentally found in germanium doped with P, As, Sb, Bi following γ irradiation at room temperature. This effect is thought of as the formation of E-like centers, but the centers seem to be electrically inactive. The radiation-induced acceptors in the lower half of the forbidden gap are formed presumably from vacancy—donor centers by vacancy trapping (divacancy—donor formation). Based on the dependence of carrier removal rate on initial carrier density, the upper electronic level of a free vacancy is estimated as 0.33 eV below the conduction band. (auth)

6402 CHARGE-STATE DEPENDENCE OF DEFECTS PRODUCED IN ELECTRON-IRRADIATED SILICON. Naber, J. A.; Mallon, C. E.; Leadon, R. E. (Gulf Radiation Tech., San Diego, CA). pp. 26-33 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

The introduction and annealing (thermal and injection) characteristics of damage in high-purity n- and p-type silicon after electron irradiation are used to identify the energy level position and charge state of the defects initially produced. In n-type silicon a level at $E_c - 0.39$ eV $\left(\frac{-}{0}\right)$ and in p-type silicon a level at $E_v + 0.46$ eV $\left(\frac{0}{+}\right)$ are identified. (The symbol $\left(\frac{0}{+}\right)$ denotes a defect that is neutral when it is below the Fermi level or positive when it is above the Fermi level; $(\overset{-}{0})$ denotes a defect that is negative when it is below the Fermi level or positive when it is above the Fermi level.) These initial defects anneal to form vacancy–phosphorus centres in n-type material and divacancies in p-type material. It is argued that the defects produced initially in n- and p-type materials are the same, having two energy levels and three charge states. It is felt that this defect is the vacancy. (auth)

6403 ELECTRON-IRRADIATION-DAMAGE STUDIES IN INDIUM ARSENIDE. Lindsay, D. J. C.; Banbury, P. C. (Reading Univ., Eng.). pp 34–41 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Measurements are reported of Hall effect and conductivity on electron-irradiated n- and p-type InAs. The carrier density in n-type material at 80°K was found to increase linearly with dose (to 10^{16} electron/cm^2), and to recover on annealing with stages centered at 160, 250, and 330°K. Damage rates for defects in these stages were examined as a function of electron energy from 0.4 to 2.0 MeV, for irradiations in $\langle 111\rangle$ and $\langle\bar{1}\bar{1}\bar{1}\rangle$ directions. Results on the two lowest temperature stages were obtained by irradiation at helium or nitrogen temperature; other irradiations were performed at room temperature. Isothermal anneals failed to establish simple kinetics for any stage. Photoconductivity studies showed an overall enhancement of signal after irradiation at 80°K and a level was indicated at −0.38 eV. The enhancement of signal was removed by annealing at 280°K; no structure was seen to correlate with the annealing of dark conductance. Computer simulation of damage rates was attempted by adapting the model previously described for silicon. Modifications included the use of scattering cross sections valid for $Z \leq 80$. Computed results suggested that all the defects which anneal are consequent upon the displacement of arsenic atoms. It is suggested that the lowest stage may relate to close Frenkel pairs, the higher ones both to the longer range displacements. Calculation of divacancy production rates gave a good fit to damage rates for defects unannealed at 380°K. Measurements of specimen conductance only on p-type samples gave linear behavior with dose over a limited range up to about 10^{15} electron/cm^2. The same annealing temperatures were found as in n-type, indicating that the same migration or dissociation events were occurring. Damage rate studies were consistent with the assumption that the same displacement events were involved in each stage in p- and n-type. (auth)

6404 ATOMIC DISPLACEMENT ENERGIES IN ZINC TELLURIDE. Bryant, F. J.; Baker, A. T. J. (Hull Univ., Eng.). pp. 45–50 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

The cathodoluminescence edge emission spectrum of p-type zinc telluride at approximately 10°K was studied before and after irradiation with monoenergetic electrons in the range 70 to 500 keV. Production of a bound exciton emission at 2.362 eV after electron radiation damage at 77°K leads to the determination of an energy threshold of 300 keV for atomic displacement. Another bound exciton emission at 2.358 eV is produced by electron radiation damage with an energy threshold calculated to be 110 keV for samples damaged at 77°K and 235 keV for samples damaged at approximately 10°K. The 300-keV threshold energy is assigned to the displacement of tellurium (corresponding to a maximum energy transfer of 6.7 eV). The lower energy threshold is thus assigned to the displacement of zinc and corresponds to a maximum energy transfer of 4.2 eV (≡110 keV) at 77°K and 9.7 eV (≡235 keV) at approximately 10°K. The annealing characteristics for each damage induced defect were studied and in each case the damage was found to anneal completely in a single stage. Difficulties encountered in using intensity enhancements of bound exciton emission and donor–acceptor pair recombination emission for threshold energy determinations are discussed briefly. (auth)

6405 ZINC DISPLACEMENT THRESHOLD AND Zn VACANCY LUMINESCENCE IN ELECTRON-IRRADIATED ZnTe. Meese, J. M. (Univ. of Dayton, OH); Park, Y. S. pp. 51–59 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Two optical emission series in ZnTe, with zero-phonon lines at 2.320 and 2.234 eV, were observed to increase in intensity during electron irradiation above a threshold electron energy of 185 keV. This threshold has been assigned to the displacement of Zn atoms by comparison with the cation displacement thresholds in other II-VI compounds and by a consideration of lattice bond energy estimates. A model is presented in which the observed luminescence is the result of a radiative recombination of electrons from the conduction band with holes trapped at double acceptor Zn–vacancy levels 0.065 and 0.151 eV above the valence band. Experimental results supporting this model are presented. (auth)

6406 RADIATION DAMAGE DURING ION IMPLANTATION. Vook, F. L. (Sandia Labs., Albuquerque, NM). pp. 60–71 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Ion implantation provides a controlled method for studying high defect concentrations in crystalline semiconductors and the transition to the amorphous state. Experimental results of the crystalline-to-amorphous transition in silicon for many implantation parameters are correlated in terms of the energy deposited into atomic (nuclear) processes. At low implantation temperatures the amorphous transition depends primarily on the properties of silicon rather than on those of the implanted ion, and the transition occurs for 6×10^{23} eV cm^{-3} deposited into atomic (nuclear) processes. At implantation temperatures near and above room temperature, defect annealing and interactions with the high concentrations of implanted ions give an increasing dependence of the amorphous transition on the implanted ion type. If the energy into electronic processes creates an electron density exceeding threshold values, it is suggested that charge state-dependent intrinsic defect annealing and interactions with the implanted ions can occur. Isotopic ion implantation and the incorporation of these ions into crystalline defects in silicon is an example of an important and successful new application of ion implantation to studies of the microscopic nature of defects in semiconductors. (auth)

6407 DEFECT FORMATION IN ION-IMPLANTED SILICON. Gerasimenko, N. N.; Dvurechenskii, A. V.; Romanov, S. I.; Smirnov, L. S. (Inst. of Physics of Semiconductors, Novosibirsk, USSR). pp. 72–80 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF 720713-.

The appearance of a paramagnetic defect with g = 2.0055 (the vacancy void or VV center) was observed as a result of ion implantation of silicon. The accumulation kinetics of VV centers, the connection of this with amorphization, the depth distribution of the disordered structure and the observed paramagnetic centers were studied for different doses, energies, and masses of ions. The VV center is a secondary defect arising from the interaction of the disordered regions. These individual disordered regions are not primarily amorphous. The annealing of VV centers took place more readily in the "tail" of the depth distribution. The annealing temperature increased with ion dose and energy. An interaction between impurities and defects was observed during ion implantation. In B^+ and P^+ implanted silicon the amorphous layers were restored at a high dose level but there was no such effect under Ar^+ implantation. The results obtained are discussed using the model suggested by the authors. (auth)

6408 DEFECT-CENTRE STUDIES IN BORON-IMPLANTED SILICON. Karatsyuba, A. P.; Kurinnyi, V. I.; Rytochkova, S. V.; Timashova, T. P.; Yudin, V. V. pp. 81–86 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Silicon p–n junction samples were irradiated by 40, 100, and 200-keV boron ions with a dose of 6.2×10^{14} ion/cm^2 at temperatures −190, 24, 200, and 600°C. The reverse generation current was studied as a function of the annealing temperature and the measurement temperature. Two types of defect centers were found. Defect centers with electronic thermal activation energy equalling 0.25 ± 0.03 eV appeared during implantation at 24 to 200°C and disappeared after annealing at 400 to 500°C. Annealing of boron-implanted silicon at 500 to 600°C results in the formation of centers with electronic thermal activation energy equalling 0.41 ± 0.04 eV, the centers being completely degenerated by subsequent heat treatment at 700 to 800°C. Variation of ion energy from 40 to 200 keV had no significant effect on the nature of the defect centers, but shifted the defect concentration maximum along the p–n junction. Electron microscopy studies allowed speculations to be made about the nature of the defect centers. (auth)

6409 TRANSIENT ANNEALING OF 14-MeV NEUTRON DAMAGE IN SILICON. Srour, J. R.; Curtis, O. L. (Northrop Corporate Labs., Hawthorne, CA). pp. 87–95 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

An investigation of transient annealing in 14-MeV neutron-irradiated silicon was performed employing a dense-plasma-focus fusion neutron generator. Results of companion experiments performed at a fission-neutron source (Triga reactor) are utilized to make fusion–fission unstable damage comparisons. For equal amounts of stable damage, the fusion–fission unstable damage ratio at both 0.02 and 0.2 s after irradiation is approximately 1.75. At 2 s, this ratio is approximately 1.50. Annealing data correlate reasonably well with electron density, a result previously observed for fission-neutron-irradiated silicon by other workers. A model is proposed to explain the observed transient annealing differences between 14 MeV and reactor-neutron-irradiated material, and is based on differing defect densities within disordered regions created by fusion and fission neutrons. (auth)

6410 MODEL FOR DAMAGE PRODUCED BY FAST NEUTRONS IN GALLIUM ARSENIDE. Coates, R.; Mitchell, E. W. J. (Reading Univ., Eng.). pp. 96-102 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Results of recent measurements of optical absorption, x-ray diffraction, neutron scattering, and electrical conductivity as a function of neutron dose up to doses of 1.5×10^{20} neutron/cm^2 are summarized. A model is presented in which the distribution of defects is highly nonuniform at low doses but in which the material retains overall crystallinity at all doses. (auth)

6411 EFFECTS OF NEUTRON IRRADIATION ON ELECTRICAL PROPERTIES OF HEAVILY DOPED p-TYPED GaAs AND THE MOTT TRANSITION. Mora, N. A.; Loferski, J. J.; Bermon, S. (Brown Univ., Providence). pp. 103-112 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

The effects of fast neutrons from a reactor on the Hall coefficient and electrical conductivity of heavily doped (1 to 8×10^{18} cm^{-3}) p-GaAs were investigated. The samples were irradiated at about 50°C; the measurements were made over the range 1.4 to 300°K. The room-temperature carrier removal rate was found to depend strongly on the pre-irradiation value of p. It has a maximum value (or perhaps a saturation value) of 36 cm^{-1} at $p \sim 6.5 \times 10^{18}$ cm^{-3} and decreases towards the commonly observed value of about 6 cm^{-1} when p decreases to 1×10^{18} cm^{-3}. Both the conductivity and Hall mobility at 1.4°K decrease with decreasing free carrier concentration. The rate of decrease is particularly rapid when the carrier concentration is in the vicinity of the Mott (semiconductor-to-metal) transition—i.e., around 2×10^{18} cm^{-3}. The behavior of the Hall coefficient and the electrical conductivity is reminiscent of the behavior of the zero-bias conductance of Pb–GaAs Schottky barrier tunnel junctions, which also undergo rapid changes when the carrier concentration is driven through the Mott transition by neutron-irradiation-induced carrier removal. (auth)

6412 NEUTRON DISPLACEMENT DAMAGE IN HEAVILY DOPED GaAs. Euler, F. (Air Force Cambridge Research Labs., Bedford, MA); Bouthillette, L.; Kahan, A.; Stein, H. J. pp. 113-120 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Infrared optical reflectivity measurements are applied to determine the carrier-removal rate and mobility changes of heavily doped n- and p-type GaAs. The initial carrier removal rates are 10 ± 2 and 42 ± 4 cm^{-1} for n- and p-type samples with initial carrier concentrations of 6×10^{18} and 4×10^{19} cm^{-3} respectively. Reciprocal mobility changes linearly with fluence in n-type and saturates in p-type samples. Carrier removal and mobility degradation are insufficient to explain all neutron-induced changes in the reflectivity spectra. (auth)

6413 ANNEALING OF DEFECTS AND FORMATION OF CLUSTERS IN n-TYPE GaAs UPON ELECTRON IRRADIATION. Brailovskii, E. Yu. (Inst. of Nuclear Research, Kiev); Broudnyi, V. N.; Groza, A. A. pp. 121-128 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

The annealing behavior of electrical properties and ir absorption at 300°K in n-GaAs irradiated at 20 to 100°C with various doses of between 1.0 and 45-MeV electrons was investigated. The isochronal annealing showed that, depending on the dose of 1.0 to 10-MeV electrons, two annealing stages can be observed. At small doses only the first stage (200 to 300°C) was observed, and at large doses the second stage appeared (300 to 500°C), the role of which in the total annealing rises with irradiation. The second stage is explained by annealing of clusters forming as a result of point-defect agglomeration at large irradiation doses. The clustering suggests that the boundary position of the Fermi level, like that observed for neutron irradiation, is situated approximately in the middle of the gap. Defect annealing even after irradiation with small fluxes of 45-MeV electrons has two stages: at 200 to 300°C, point-defect annealing occurs, and the 400 to 600°C stage is explained by disordered-region annealing. In heavy 2-MeV electron-irradiated samples, inselective absorption in the range of 0.4 to 1.4 eV and an absorption band at 1.0 eV were observed, the latter being tentatively speculated as being due to divacancies. (auth)

6414 RECOMBINATION CENTRES IN n- AND p-TYPE SILICON IRRADIATED BY VERY-HIGH-ENERGY PROTONS. Bielle-Daspet, D. (Univ., Toulouse). pp. 129-139 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Properties of the carrier recombination centers created, at room temperature, by 207, 590, and 3000-MeV proton irradiations of silicon single crystals are deduced from the variations in the carrier lifetime against sample characteristics, carrier injection rate, proton fluence and temperature. Measurements are performed using a neodymium laser for the observation of photoconductivity decay. Comparison of results obtained from lifetime and Hall effect measurements together with results given by electron irradiations are used for interpreting the above properties in terms of specific defects and lattice damage. Two recombination centers, with approximate $E_c - 0.18$ and $E_v + 0.25$ eV energy levels, appear especially important in proton-irradiated n- and p-type silicon respectively. Both seem impurity-independent defects, stable to over 400°C. Moreover the enhancement of their effectiveness, under and following proton irradiation, points to vacancy migration from clusters and the annealing of divacancies and impurity-vacancy complexes. These defect characteristics would be consistent with multiple-vacancy centers. (auth)

6415 CLUSTERING OF DEFECTS IN IRRADIATED SEMICONDUCTORS. Nelson, R. S. (Atomic Energy Research Establishment, Harwell, Eng.). pp. 140-158 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

The agglomeration of point defects in irradiated semiconductors is manifest in two ways: namely, by the creation of high disordered essentially amorphous material and by the formation of dislocation structures which are observable in the electron microscope. In this review the conditions necessary for the formation of both amorphous regions and other defect clusters are discussed. Defect clusters sufficiently large to be seen in the electron microscope generally require irradiation to high doses; consequently, the review is concerned primarily with damage produced by ion bombardment and by electrons in the high-voltage electron microscope. The radiation damage produced by heavy ions, light ions, and electrons is considered, and the evolution of defect clusters as a function of irradiation dose and temperature is highlighted. Furthermore, the residual defect structures that remain after annealing are identified. Finally, some consideration is given to the understanding of the observations. (auth)

6416 DAMAGE PRODUCED AROUND ION TRACKS IN IMPLANTED SILICON. Bertolotti, M.; Sette, D.; Stagni, L.; Vitali, G. (Univ., Rome). pp. 159-164 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Examination of Si samples implanted along a channelling direction with 30-keV In ions is reported. A small fraction of the implanted ions penetrates very deep in the semiconductor, down to several micrometers below the Si surface. At the end of the path of these ions a damage region is visible that is considered to be an example of a thermal spike. (auth)

6417 DEFECT CLUSTERS IN NEUTRON-IRRADIATED SILICON SOLAR CELLS. Ghosh, S.; Sargent, G. A. (Univ. of Kentucky, Lexington). pp 165-169 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Electron microscopy was used as a technique to observe the distribution and morphology of lattice defects introduced into undoped and lithium-doped silicon solar cells, of doping level 10^{15}, 10^{16}, and 10^{17} lithium atoms/cm^3, by neutrons produced by a Cockcroft–Walton generator to doses of 10^{10}, 10^{11}, 10^{12}, and 10^{13} neutrons/cm^2. Damage to the cells produced by the irradiation could be observed as etch pits, in the form of shallow craters, by surface replication electron microscopy. The observed defects are thought to be related to the space charge region around vacancy clusters. The crater-like defect density was found to increase with increased irradiation dose and increased lithium content; however, the mean defect diameter was found to decrease with increasing dose and amount of lithium. Annealing experiments showed that the crater defects were stable in the temperature range 300 to 900°K in all of the doped samples. Some annealing of the defects was observed to occur in the undoped cells which were irradiated at the lowest doses. The occurrence of the crater defects is in accord with the theoretical models for neutron-irradiated semiconductors proposed by Gossick (J. Appl. Phys.; 30: 1214 (1959)) and Crawford and Cleland (J. Appl. Phys., 30: 1204 (1959)). (auth)

6418 ROLE OF DEFECTS IN DIFFUSION. Peart, R. F. (Plessey Co. Ltd., Towcester, Eng.); Newman, R. C. pp 170–181 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Data for diffusion and for defect migration resulting from irradiation and annealing studies are reviewed. Selected examples, predominantly from silicon data, are discussed with the objective of determining to what extent common processes are responsible for migration of defects at high and low temperatures. It is shown that the interpretation of diffusion studies is a complex problem because of the frequent use of nonideal experimental conditions and that, although a large body of data exists, there are relatively few examples of self or impurity diffusions for which the mechanism is established. Correlation with low-temperature defect studies is inconclusive and the latter data are limited in scope. Areas where further work should help resolve unanswered problems are indicated. (auth)

6419 DEFECT INTERACTIONS IN NEUTRON-IRRADIATED, LITHIUM-DOPED SILICON. Kimerling, L. C. (Air Force Cambridge Research Labs., Bedford, MA); Drevinsky, P. J.; Chen, C. S. pp 182-190 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

The influence of lithium doping on neutron-produced defect introduction and stability in silicon is studied by Hall effect and ir-absorption measurements. During irradiation, an enhanced carrier-removal effect is observed in Li-doped silicon which is accompanied by a decrease in the LiO^+, 9.85-μm, absorption band and an increase in the interstitial-oxygen, 9-μm band. During subsequent heat treatment, both crucible-grown and float-zoned, Li-doped materials exhibit continued carrier loss together with a growth of three new absorption bands at 1.36, 1.60, and 2.14 μm. Upon heating above 200°C, these bands disappear and the 9.85 μm band reappears. These results are shown to be consistent with a precipitation-like interaction between lithium impurities and neutron-produced defect clusters. (auth)

6420 SELECTIVE TRAPPING OF VACANCIES. Brelot, A. (Ecole Normale Superieure, Paris). pp 191-201 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF 720713-.

Silicon samples containing high concentrations of germanium, tin, and oxygen were irradiated with 3-MeV electrons. The production rate of various defects which are associated with these impurities has been obtained by infrared absorption measurements. It is shown that the addition of germanium (or tin) impurities reduces the diffusion length of free vacancies produced by irradiation while the migration of intrinsic interstitials is not modified at all. In order to know which defect—or interstitial—has interacted with an impurity and formed a particular pair, the production rate of pairs containing silicon in Ge of Sn was compared with the corresponding production rate in reference silicon. In the past it has been difficult to identify the interstitial in pairs which were not observed by EPR; however, by irradiating tin containing silicon it was concluded that the 935 cm^{-1} line was produced by interstitial-type defects only (intrinsic interstitial–oxygen pair). An important simplification brought by the selective trapping method used in the radiation damage studies is the possibility of easily separating the role of interstitials from that of vacancies by carrying out an irradiation (electrons or ions) at room temperature only. The selective trapping method may be applied to any material (semiconductors or metals) by using any simple detection method (resistivity measurements for instance). Further applications in enhanced diffusion phenomena and in ion implantation studies are suggested. (auth)

6421 ESR STUDIES OF NEUTRON-IRRADIATED DIAMOND. Kim, Y. M.; Lee, Y. H.; Brosious, P.; Corbett, J. W. (State Univ. of New York, Albany). pp 202-209 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

After fast-neutron irradiation, two new $S = 1$ centers were observed. The D-tensor analysis of $S = 1$ centers and new interstitial configurations, split-$\langle 100 \rangle$ and bond-centered, are employed in establishing models of defects which might give rise to these spectra. The newly gained understanding of the interstitial configurations is also extended to the previously identified ESR spectra to establish defect models. (auth)

6422 HIGHER-ORDER-DEFECT INFRARED ABSORPTION BAND IN Si. Chen, C. S.; Vogt-Lowell, R.; Corelli, J. C. (Rensselaer Polytechnic Inst., Troy, NY). pp 210-217 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF 720713-.

After heat treatment to 300°C, a series of sharp new infrared-absorption bands due to two defects is observed in high-energy electron- or fast neutron-irradiated n-type ($\rho \geq 10\ \Omega$ cm) and p-type ($\rho \geq 1\ \Omega$ cm) and intrinsic float-zone-refined silicon. An intense band due to one of the defects is observed at 1124 cm^{-1} with an associated weaker band at 1233 cm^{-1}. Another group of weaker bands due to the second defect are found in the 1000 to 1300 cm^{-1} region which are associated with a dominant band at 1104 cm^{-1}. All bands were observed only at low temperature (4.2 to 110°K). The 1124 cm^{-1} and 1133 cm^{-1} bands first appear after heat treatment to 300°C. The bands are observed only after the disappearance of the divacancy associated bands at 5880 cm^{-1} (1.7 μm), 2900 cm^{-1} (3.45 μm), and 2765 cm^{-1} (3.61 μm). The intensity of these new bands is directly proportional to the number of the divacancy defects. The spectra are due to electronic excitation and recover in two stages at approximately 465 and 575°C. Low-temperature (78°K) uniaxial stress response using polarized light have been measured on the second defect in oriented single crystals. All bands exhibit both dichroism and splitting under the effect of stress. The number of split components and the sense of dichroism are the same but different in magnitude. From the splitting of the bands, the symmetry of the defect centers is deduced to be trigonal with the defect axis pointing along the [111] axis. The defect centers responsible for the bands are found to be impurity independent and consist of at least a triple vacancy or a double divacancy. (auth)

6423 BINDING ENERGY BETWEEN A GROUP V IMPURITY ATOM AND A VACANCY IN SILICON. Yoshida, M. (Musashino Electrical Communication Lab., Tokyo); Hasiguti, R. R. pp 223-227 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF 720713-.

The activation energy of diffusion of a group V impurity atom (P, As, Sb, Bi) in silicon E_{imp} is given by the sum of migration and formation energies of an impurity-vacancy pair, E_g and $E_f - E_b$, where E_f is the formation energy of a vacancy and E_b is the binding energy between an impurity and a vacancy. Using this relation and experimental values of E_{imp}, E_g, and E_f, a new value of $E_b = 1.9$ eV is obtained. This new value is independent of impurity species. The fact that E_g is dependent on impurity species while E_b is not is discussed in terms of the interaction potential model and the qualitative consideration of electronic structures of defects. (auth)

6424 VACANCIES AND INTERSTITIALS IN SEMICONDUCTORS. Watkins, G. D. (General Electric Co., Schenectady, NY). pp 228-237 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Experimentally known properties of vacancies and interstitials in the group IV (Si) and II-VI (ZnS, ZnSe, ZnO, BeO, CdO) semiconductors are reviewed briefly along with corresponding information for the alkali halides. Large Jahn–Teller distortions (~1 eV) appear to occur whenever partially filled p-orbitals exist on the atoms immediately involved. This applies to vacancies in group IV semiconductors, metal vacancies in all the compound materials, and interstitial halogen atoms in the alkali halides. In all cases, simple one-electron molecular orbital models appear to provide a satisfactory framework for understanding the defects. This is interpreted to indicate that many-electron correlation effects are relatively small and direct experimental evidence for this is presented for defects involving vacancies in silicon. This is in conflict with conclusions based on the Coulson–Kearsley–Yamaguchi theory, and it is suggested that this arises from the failure of the theory to account properly for delocalization of the defect orbitals in the solid. (auth)

6425 THEORY OF DEFECT ENERGIES AND STATES. Lidiard, A. B. (Atomic Energy Research Establishment, Harwell, Eng.). pp 238-248 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

A review is presented of recent theoretical work on the energy levels, quantum states, and atomic configurations of simple defects in covalent solids. In fact this work has been largely concentrated on vacancies in diamond and Si. The two principal methods used are the defect–molecule method, originated by Coulson and Kearsley, and the extended Hückel method. The defect–molecule method sets out from assumed localized orbitals (a nondegenerate a_1 and a 3-fold degenerate t_2 lying above it) and carries out a systematic quantum-mechanical treatment of the coupled states of the several localized electrons moving in the field of the rest of the solid. It permits the calculation of energy levels, states, and coupling of the defect to the lattice. Some features, for example the order of closely spaced levels, are sensitive to the atomic orbitals used as basis for the localized defect orbitals, but a generally consistent pattern emerges in which interelectronic interactions are important. The forces exerted by the defect on the surrounding lattice are also large but are overestimated by this theory at present. In contrast to the defect–molecule method, the extended Hückel calculations aim to calculate the localized orbitals a priori. This has been mainly done by attempting to simulate a section of the solid by modelling a large molecule or cluster of atoms in the correct coordination. The method is quick in practice and has heuristic value. However, the predictions depend on the size of cluster and the boundary conditions. It also lacks self-consistency and thus from a fundamental point of view does not obviously provide better one-electron orbitals than those assumed on intuitive grounds in the defect–molecule method. At present the extended Hückel and other one-electron methods give a wide spread of possible solutions, ranging from the prediction of no localized one-electron orbitals to several. There is thus a need for more rigorous and self-consistent calculations of the one-electron states. For studies on clusters, several approximate, but self-consistent and well-tried, molecular methods are readily available, for example CNDO/2, and should be fully explored. (auth)

6426 VACANCY CENTRES IN THE DIAMOND LATTICE: A CRITIQUE OF CURRENT THEORETICAL TREATMENTS. Coulson, C. A. (Oxford Univ.). pp 249-254 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

An account is given, first of the defect–molecule model of Coulson and Kearsley for the electronic levels associated with a single vacancy in diamond, and then of the three major deficiencies of this model. These are (i) a too-severe localization of the defect electrons, (ii) an inability to take account of relaxation around the vacancy, and (iii) a neglect of the Jahn–Teller effect. This is followed by a brief description of the new model of clusters of atoms around a vacancy, formulated by Messmer and Watkins, using the extended Hückel approximation. The successes of this model in dealing with the three deficiencies in the Coulson–Kearsley model, are stressed, and then some of the difficulties and uncertainties in this new method are brought into the open and discussed. It is concluded that a definitive account of the phenomenon requires a new theory, embracing the good points of both previous models. (auth)

6427 CALCULATIONS OF DEFECTS IN THE DIAMOND LATTICE. Messmer, R. P.; Watkins, G. D. (General Electric Co., Schenectady, NY). pp 255-261 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

A new approach to the theoretical treatment of a defect in a semiconductor lattice is presented. A cluster of host atoms was formed surrounding a defect and the entire system treated as a large molecule using semi-empirical LCAO–MO methods. As an example, a solution was given for the electronic structure of a vacancy in a 35-atom diamond cluster using the Extended Hückel Theory (EHT), a simple one-electron molecular orbital technique. Several useful extensions to the method are explored: (i) the effect of cluster size is investigated by adding successive shells up to 71 atoms; (ii) the surfaces are eliminated entirely by imposing periodic boundary conditions on the cluster; (iii) the EHT method is parameterized by matching the results of an EHT band-structure calculation to the known band structure for the host material. Results on the lattice vacancy in diamond are described. (auth)

6428 SELF-INTERSTITIALS IN SILICON AND GERMANIUM. Seeger, A.; Frank, W. (Max-Planck-Institut fuer Metallforschung, Stuttgart). pp 262-268 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Starting from theoretical considerations, it is emphasized that the geometrical configuration and the migration energy of self-interstitials in silicon and germanium should depend on the charge state and hence on the position of the Fermi level. An assignment of donor and acceptor levels and of diffusivities to the various charge states of interstitials is proposed. It is shown that this assignment is capable of explaining a large body of experimental data on radiation damage, diffusion, and quenching. (auth)

6429 EVIDENCE OF 130K ANNEALING STAGE OF DIVACANCY IN ELECTRON-IRRADIATED SILICON. Massarani, B.; Brelot, A. (Ecole Normale Superieure, Paris). pp 269-277 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

High-purity and pulled low-resistivity p- and n-type samples of single-crystal silicon were irradiated with 3-MeV electrons at 90°K. Infrared-transmission spectra were recorded at 77°K after irradiation and after several annealing stages. Near-edge and divacancy absorption bands (at 1.7 μm in high-purity samples, at 1.7 and 3.9 μm in p-type, 1.7, 3.46 and 3.62 μm in n-type samples) were observed and measured after irradiation. In all samples, except the low-resistivity p-type one, the intensity of the 1.7 μm band decreased by nearly 50% during annealing at 130°K. Similarly, the absorption coefficient measured at 1.37 μm decreased by nearly 50% during the same annealing stage. A reverse annealing of the 1.7 μm band was observed at 180°K. No change was observed in divacancy concentration in p-type Si during 130°K annealing when the Fermi level was not far from E_v + 0.25 eV. In high-purity samples the intensity of the 1.7-μm band corresponds to the total divacancy concentration. It is deduced that about 50% of the divacancies anneal at 130°K. In high-purity samples, divacancies may be annihilated only by silicon interstitial atoms and the 130°K annealing stage is therefore associated with the interstitial. The reverse annealing of the 1.7-μm band at 180°K indicates that neutral vacancies become mobile at this temperature and agglomerate. There is no direct correlation between the reverse annealing of the 1.7-μm band and that of the near-edge absorption. This indicates that near-edge absorption does not depend on divacancy concentration only, but rather reflects the total number of defects. (auth)

6430 ELECTRICAL PROPERTIES OF ZONE-PURIFIED PURE SILICON CONTAINING γ-RAY-INDUCED DEFECTS. Kholodar, G. A. (Kiev State Univ.); Vinetskii, V. L. pp 278-283 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

The equilibrium concentration P of holes is calculated for silicon with dominating divacancies that have created an acceptor level E_1 and a donor level E_2. For a sufficiently high concentration of divacancies, N, an "ultimate" position for the Fermi level can be reached. This will be the same for all silicon samples and will not change with any increase in the concentration of divacancies N, $\mu = -\frac{1}{2}(E_1 + E_2)$. To find this "ultimate" position, very pure silicon samples were irradiated with heavy γ doses. The concentration of defects created by the γ rays is higher than the initial concentration of acceptors by as many as three orders of magnitude ($N_a \approx 10^{11}$ cm^{-3}). The slope of the experimental curves lg p(1/T) was approximately $(E_1 + E_2)/2$ (0.39 eV). Analysis of the experimental data, however, lead to the conclusion that the "ultimate" state of silicon was not achieved under the conditions used. A defect of unknown origin with level E_v + 0.4 eV seemed to be dominating. (auth)

6431 INFLUENCE OF OXYGEN AND ACCEPTOR IMPURITIES ON ANNEALING OF RADIATION DEFECTS IN P-TYPE SILICON. Vavilov, V. S. (Lebedev Inst. of Physics, Moscow);

Spitsyn, A. V.; Mukashev, B. N. pp 284-288 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Both crucible-grown and float-zoned p-type silicon crystals, doped either with boron, gallium, or aluminum, were irradiated at 78 or 300°K by 1.5-MeV electrons and then were annealed at temperatures up to 700°K. Data on the concentration of radiation defects and their energy levels were derived from Hall coefficient and conductivity measurements. In the lowest oxygen-content samples, a prominent carrier concentration recovery stage, located at T > 360°K, was observed and was shown to be associated with annealing of the E_v + 0.45 eV level radiation defects. The annealing activation energy increased practically linearly with the atomic size of the impurity. Therefore it is suggested that the defects in question are complexes of vacancies with acceptor impurity atoms. (auth)

6432 INVESTIGATION OF RADIATION DAMAGE IN P-TYPE Si WITH HYDROGEN IMPURITY AND HIGH-PURITY n-TYPE Si. Konozenko, I. D.; Galushka, A. P.; Starchik, M. I.; Levchuk, L. V.; Khivrich, V. I. (Inst. of Nuclear Research, Kiev). pp 289-294 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Radiation defects created by ^{60}Co γ-ray, 1.2-MeV-electron, and fast-neutron irradiation in high-purity n-type Si (2×10^3 to 1.5×10^4 Ωcm), p-type Si (3×10^4 to 8×10^4 Ωcm) grown by zone floating of material of high purity and p-type Si of 300 Ωcm resistivity grown by zone floating in a hydrogen atmosphere are investigated by measurements of Hall effect and resistivity. The oxygen concentration in the crystals is in the range of 5×10^{14} to 5×10^{15} cm^{-3}. It is shown that with γ and electron irradiation of p-type Si (ρ = 300 Ωcm) grown in a hydrogen atmosphere, the hole concentration increases with dose, reaches saturation at the value $p \simeq 1.2 \times 10^{14}$ cm^{-3}, and at the highest irradiation decreases as for the irradiation of conventional Si. The fast pile neutron irradiation at 300°K of high-purity n-type Si leads to rapid decrease of electron concentration ($n \simeq \varphi^{-1.9}$), converting to p-type Si, with hole density increase to the value (0.8 to 2) $\times 10^{12}$ cm^{-3} followed by hole density decrease to the intrinsic value. The annealing of irradiated high-purity Si occurs in three stages. After 50 to 300°C anneal, the hole density increases and divacancies appear. After 300 to 550°C anneal, the hole density can exceed the pre-irradiated value by more than an order of magnitude and the levels at E_v + (0.13 to 0.16)eV and E_v + (0.08 to 0.12)eV appear. The carrier density recovery occurs after 550 to 800°C annealing. After γ irradiation of high purity n-type Si with oxygen concentration of less than 10^{17} cm^{-3}, the presence of a previously unknown 150 to 180°K reverse annealing stage with an activation energy of 0.5 ± 0.1 eV was observed for which close Frenkel pairs are thought to be responsible. (auth)

6433 SPECIFIC OBSERVATIONS OF RADIATION EFFECTS IN SEMICONDUCTORS BY JUNCTION-CAPACITANCE TECHNIQUES. DeAngelis, H. M.; Diebold, J. W.; Kimerlig, L. C. (Air Force Cambridge Research Labs., Bedford, MA). pp 295-301 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Capacitance–voltage and transient-capacitance measurements were made on Schottky-Barrier on phosphorus-doped silicon diodes. Energy levels, emission coefficients, and associated introduction rates were determined for defects produced by 1.0-MeV electrons, ^{60}Co γ rays, and 5-MeV neutrons. Total defect introduction rates agree well with carrier removal data of companion Hall effect samples. In the electron- and γ-irradiated samples, specific introduction data reveal radiation-induced traps at $E_c - 0.24$ eV, $E_c - 0.44$ eV, and below midgap. The introduction rate of the traps located below midgap exhibits a strong dependence on donor concentration. In neutron-irradiated, float-zoned silicon a band of shallow trap levels is evident along with levels at $E_c - 0.37$ eV, $E_c - 0.40$ eV, and below midgap. In neutron-irradiated, crucible-grown silicon, trap levels are observed at $E_c - 0.18$ eV, $E_c - 0.23$ eV, $E_c - 0.24$ eV, $E_c - 0.31$ eV, and below midgap. (auth)

6434 DIVACANCY-LIKE ADSORPTION IN ION-BOMBARDED Ge. Stein, H. J. (Sandia Labs., Albuquerque, NM). pp 315-321 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

A prominent optical absorption band at 2.40 μm was observed in Ge following 400-keV H^+, O^+, or B^+ ion bombardment at approximately 90°K. Subsequent heating to 150°K increases the 2.4-μm band, which then anneals out between 150 and 250°K with an experimental activation energy of 0.62 eV. Band-gap light speeds up the annealing and reduces the activation energy. Below 150°K, photons of approximately 0.75 eV induce a second band at 2.72 μm and decrease correspondingly the 2.4-μm band. Reheating to 150°K restores the 2.4-μm band. From correlations with defect characteristics in Si, and because the divacancy is a prominent defect in ion-bombarded Si, the 2.4-μm band is tentatively ascribed to the divacancy in Ge. (auth)

6435 STUDY OF DEFECT TRANSFORMATIONS IN n- AND p-TYPE GERMANIUM IRRADIATED WITH ELECTRONS AT 85K. Kraitchinskii, A.; Rzewuski, H.; Suski, J.; Werner, A.; Kozanecki, A. (Inst. of Nuclear Research, Warsaw). pp 322-327 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Annealing processes in germanium irradiated with a heavy dose of 1-MeV electrons at 85°K and the effect of background ionization upon annealing were studied in the temperature range 85 to 350 K for samples doped with various concentrations of n- and p-type impurities. A general similarity between the annealing behavior of converted n- and p-type germanium samples were noticed. On the basis of the model of a widely spaced Frenkel pair, the processes observed are interpreted as a release of vacancies, owing to the dissociation of Frenkel pairs, and their subsequent migration and formation of complexes with impurities and other vacancies. (auth)

6436 $E_c - 0.2$ eV LEVEL IN GERMANIUM. Fukuoka, N.; Saito, H.; Tatsumi, Y. (Osaka Univ.). pp 328-334 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

The defect associated with the $E_c - 0.2$ eV level formed in n-type germanium after electron irradiation was extensively studied. It was ascertained that the level is formed in n-type germanium regardless of the dopants from group V, phosphorus, arsenic, antimony, as well as the impurities oxygen and tellurium. It was also observed that the partial compensation of the dopant with impurities of group III does not obstruct the formation of the level. The introduction rate of the 0.2-eV level was found to increase with increasing impurity concentration. As is well known, this level is not the only one which removes carriers from the conduction band, and the fraction of the electrons removed by the 0.2-eV level to the total number of electrons removed was measured as a function of the irradiating energy. The fraction for 1.5-MeV irradiations was found to be about three times as large as that for 10-MeV irradiations. These results strongly support the model that the defect is an association of vacancy and impurity atom. The defect is annealed in the temperature range 350 to 450°K with an activation energy of 1.2 eV both in arsenic- and antimony-doped samples. (auth)

6437 ELECTRON IRRADIATION OF GERMANIUM CONTAINING UNUSUAL DONORS AND ACCEPTORS. Hiraki, A.; Fukunaga, K. (Osaka Univ.). pp 335-340 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Some of the effects occurring in germanium, as well as in silicon, during electron bombardment have been attributed to the presence of impurities. Most of this work has been on germanium containing the usual group III or group V impurities on substitutional sites giving acceptors and donor. Another approach is suggested to the impurity effect problem by employing specimens with unusual acceptors and donors. Use was made of n-type samples containing clusters of four interstitial oxygen atoms (O_4) as donors and p-type samples produced from pure material either by fast-neutron irradiation or by quenching from high temperature. (auth)

6438 EFFECTS OF GAMMA IRRADIATION ON p-TYPE GERMANIUM COMPENSATED BY LITHIUM. Urli, N. (Institut Rudjer Boskovic, Zagreb); Desnica, U. V.; Riepe, G.; Protic, D. pp 341-347 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Gallium-doped germanium (''Hoboken'' 17 Ωcm), homogeneously compensated with lithium by the standard drift technique, proved to be p-type after ageing at room temperature for several days. Two series of such samples were irradiated in a ^{60}Co γ source at 77°K, the first, a few days after preparation, and the second, stored at –70°C, 6 months later, with doses of about 3×10^{15} and 7×10^{15} photon/cm^2, respectively. Both donors and acceptors were introduced during irradiation, the latter being predominant. Four annealing stages were determined by isochronal and isothermal annealing studies up to 293°K. In contrast with the well-known behavior of irradiated p-type Ge, not compensated by lithium, there was a significant increase in concentration of acceptors and an increase in concentration of the energy levels located at $E_v + 0.27$ and $E_v + 0.07$ eV at the first two stages. A highly conductive layer beneath the surface was found after annealing at room temperature. Results are compared with those already published and discussed in view of the important role of lithium in annealing processes. (auth)

6439 ELECTRICAL CONDUCTION OWING TO DEFECT CENTRES PRODUCED BY ION IMPLANTATION IN GALLIUM ARSENIDE. Kato, Y.; Shiraki, Y.; Shimada, T.; Komatsubara, K. F. (Hitachi Ltd., Tokyo). pp 348-354 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

A report is presented on the formation of an amorphous layer in the single crystal of GaAs by ion implantation and the measurements of the resistivities of implanted layers with dosage and annealing procedure. Ion implantation was carried out at 50, 150, and 200 keV at room temperature, using helium, nitrogen, sulphur, and zinc ions. The dose levels were 10^{13} to 10^{16} cm^{-2}. The dose dependence of sheet resistivity of implanted layers (ρ_s) was $\rho_s \propto N_d^{-3}$, and saturated at a dose level determined by the mass and energy of implanted ions. The effective resistivity $\bar{\rho}$ which is defined by $\rho_s \times R_p$, where R_p is the projected range, depended only on the defect density. The defect density at saturation was about 5×10^{22} cm^{-3}, which is comparable with the atomic density of GaAs. This implies the formation of a perfect amorphous phase of the implanted layer, a result which agreed well with backscattering data by Harris (1971). The temperature dependence of $\lg\rho_s$ was T^{-1} above 180°K. The measured values of activation energies for carrier generation ranged from 0.087 to 0.12 eV. Below 180°K, the temperature dependence of $\lg\rho_s$ was $T^{-1/4}$. The activation energy for annihilation of defects was 0.35 eV in the present case. (auth)

6440 DEFECT STUDIES ON ELECTRON-IRRADIATED GaAs BY ELECTRICAL MEASUREMENTS. Grimshaw, J. A. (Royal Military Coll. of Science, Shrivenham, Eng.). pp 355-363 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Measurements are reported of differential capacity and conductance, as a function of reverse bias at 1592 Hz and of frequency between 40 and 50 Hz at zero bias, of GaAs p^+-n photodiodes electron irradiated at 290°K. By analysis of the frequency-dependent effects in terms of an equivalent circuit model of the specimens, it is deduced that defects were introduced with time constants for electron emission and capture greater than 3×10^{-3} and less than 10^{-4}s at 293°K. The series end resistance of the samples was also calculated. It is deduced from analysis of the reverse bias dependence of capacity that irradiation-introduced deep acceptors with levels in the top half of the gap, and with the longer of the time constants, were primarily responsible for the observed changes. The defects with shorter time constants may also have had levels in the top half of the gap, being either (i) deep acceptors or (ii) donors, plus an almost equal density of acceptors introduced in the lower half of the gap. It is unlikely that the original shallow impurities gained a negative charge. A small density of donors in the top half of the gap were formed after a long period at room temperature. These conclusions are not incompatible with those made from Hall effect and resistivity measurements. It is suggested that current–voltage characteristics, obtained by applying a fast ramp voltage to abrupt asymmetric junctions, could be used to measure carrier concentration profiles when deep defect levels are present. (auth)

6441 ELECTRON IRRADIATION OF GaAs. Kalma, A. H.; Berger, R. A.; Cesena, R. A. (Gulf Radiation Tech., San Diego, CA). pp 364-370 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Gallium arsenide, irradiated with 1-MeV electrons at room temperature, was studied using optical and electrical techniques. One of the major radiation-produced effects is an increased absorption at wavelengths longer than the fundamental edge. This "near-edge" absorption is noticeable after fluences of approximately 10^{16} electron/cm^2. Following fluences of 10^{18} electron/cm^2, this absorption extends to approximately 3 to 4 μm and is approximately proportional to $\lambda^{-2.5}$. For fluences less than or equal to 3×10^{17} electron/cm^2, the major annealing stage is approximately 250°C (activation energy (E_a) = 1.2 eV), but at higher fluences this stage decreases in importance. At higher fluences, the near-edge annealing resembles the mobility annealing, but not the carrier concentration annealing. Stages at approximately 330 (E_a = 1.2 eV) and 425°C become dominant for the near-edge and mobility, while the carriers anneal in a broad stage above 300°C. A radiation-produced band at 1.4 μm is found in Sn-doped but not in Si- or Zn-doped GaAs. This band anneals at approximately 425°C, corresponding to the highest-temperature near-edge annealing stage. This is another indication, for 1-MeV electrons, that individual defects are involved in near-edge absorption. Various carrier removal levels are observed in GaAs: about $E_c - 0.14$ eV in Sn-doped, $E_v + 0.17$ eV in Zn-doped, and $E_c - 0.02$ eV in Si-doped. Additionally, one deeper, unidentified level is produced in Si-doped GaAs. The removal rate in different types of GaAs varies between approximately 1.5 and 3 cm^{-1}, depending on chemical species (Si, Sn, or Zn) and on concentration of impurity. The rate drops as the Fermi level crosses the removal level, thus rendering the level ineffective. The removal rate increases by about 60% for 30-MeV irradiations, and the $E_c - 0.02$ eV level is then observed in Sn-doped material, indicating preferential production at higher energy and perhaps a more complex defect. (auth)

6442 INFRARED LOCAL-MODE ABSORPTION IN IRRADIATED GaP AND GaAs. Thompson, F.; Morrison, S. R.; Newman, R. C. (Reading Univ., Eng.). pp 371-376 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

It is shown that electron or neutron irradiation of GaP and GaAs reduces the concentration of boron and carbon originally present on isolated substitutional sites. The following centres were observed: (i) an interstitial defect B(1) containing a single boron atom; (ii) a complex C(1) of carbon with an intrinsic defect; (iii) an intrinsic interstitial complex P(1); and (iv) a new centre B(2) involving boron, possibly on a group V lattice site. (auth)

6443 STUDY OF POINT DEFECTS IN GALLIUM ARSENIDE USING PRECISION LATTICE-PARAMETER MEASUREMENTS. Driscoll, C. M. H.; Willoughby, A. F. W. (Southhampton Univ., Eng.). pp 377-386 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

A precision lattice-parameter measurement technique was used to study point defects in single-crystal gallium arsenide. The potentiality of the technique for studying radiation-induced defects is described, and a study of defects induced by quenching is presented. Changes in lattice parameter, observed after quenching and subsequent room-temperature annealing, were measured to a precision of ±1 part in 10^6. The dependence of the fractional change in lattice parameter on the quenching temperature yielded a value of 2.1 eV for the enthalpy of defect formation. Annealing of the defects was observed to proceed in two stages, confirming previously reported observations. Thermoelectric-effect and photoluminescence measurements were also used to identify the centres induced by the heat treatments. Two models are discussed to explain the experimental behavior. The first proposes that the defect structure in gallium arsenide consists of arsenic monovacancies and arsenic interstitials, and that arsenic monovacancies are the dominant defect species in gallium-rich gallium arsenide. The second model involves the latter defects and arsenic divacancies. The concentration of arsenic monovacancies quenched in from 1100°C is estimated on either model as of order 10^{18} cm^{-3}. (auth)

6444 ELECTRICAL AND OPTICAL PROPERTIES OF InAs AND InP COMPOUNDS AND THEIR SOLID SOLUTIONS OF InP_xAs_{1-x} IRRADIATED WITH FAST NEUTRONS AND γ RAYS. Kekelidze, N. P.; Kekelidze, G. P. (Tbilisi State Univ., USSR). pp 387-393 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

The electrical and optical properties of many InAs and InP crystals and their solid solutions of InP_xAs_{1-x} in a wide range of concentrations (3×10^{16} to 2×10^{19} cm^{-3}) and temperatures (300 to 4.2°K) were studied before and after irradiation with fast neutrons (maximum dose of 2×10^{18} neutron/cm^2) and γ rays (maximum dose of approximately 10^9 rad). The temperature dependence of concentration and mobility of the carriers were analysed and the thermal electromotive force was measured.

The optical reflection and absorption spectra in the range of 0.8 to 47.0 μm were studied. The dips associated with the appearance of radiation defects were revealed. (auth)

6445 LOW-TEMPERATURE ELECTRON IRRADIATION OF TELLURIUM. Gmelin, E. (Univ., Wuerzburg, Ger.); Saffert, R.; Landwehr, G.; Lichtenberg, W.; Klemt, P. pp 394-401 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

The first two recovery steps (at 51 and 110°K) in tellurium, irradiated at 10°K with 1-MeV electrons, were investigated in detail by isochronal and isothermal annealing experiments. Stage 1 obeys first-order kinetics with an activation energy of $E_a = 160 \pm 30$ MeV; the corresponding value for stage 2, which follows second-order kinetics is $E_a = 220 \pm 30$ MeV. Stages 1 and 3 are dose dependent, whereas stage 2 is not. The carrier removal rate is $\Delta p/\phi = 0.55$ cm^{-1} at 10°K corresponding to 0.13 holes generated per defect independently of electron energy and dose. Pre-irradiation experiments and irradiations performed at higher temperatures suggest that in stage 1 an interaction occurs between Frenkel pairs and dislocations. Stage 2 indicates free drifting of the points defects. The Hall mobility increases for a while during irradiation and depends during annealing systematically on the electron dose. Qualitative explanations of the observed phenomena are proposed. (auth)

6446 LATTICE DEFECTS AND GALVANOMAGNETIC PROPERTIES OF TELLURIUM. Koma, A.; Tanaka, S. (Tokyo Univ.). pp 402-406 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Various galvanomagnetic properties of tellurium irradiated with 1.5-MeV electrons were measured from 1.2 to 77°K. The hole concentration increases by one order of magnitude with the irradiation, and it remains nearly constant between 1.2 and 77°K. It is concluded that the levels of the lattice defects produced by the electron irradiation lie not in the forbidden band but in the valence band. This is considered to result from the peculiar band structure of tellurium. (auth)

6447 BEHAVIOR OF DEFECTS IN IRRADIATED CdTe. Taguchi, T.; Shirafuji, J.; Inuishi, Y. (Tokyo Univ.). pp 407-415 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Photoluminescence spectra were measured at 4.2 and 77°K in electron- or neutron-irradiated samples with and without heat treatment in excess or dissociative Cd pressure. Treatment in excess Cd vapour gave rise to a shift of the 1.42-eV band to lower energies and a new emission band at 1.15 eV accompanied by type conversion. The time-resolved measurement confirmed that the 1.42-eV band in n-type or highly compensated p-type samples involves transitions between donors and acceptors, donors being related to interstitial Cd atoms or Te vacancies. Heat treatment in dissociative Cd vapour caused a remarkable reduction in intensity of whole emission band. In neutron-irradiated samples, an intense emission band at about 1.1 eV was found and its appearance was independent of heat treatment prior to the irradiation. This band is tentatively attributed to an aggregate of defects. (auth)

6448 ANALYSIS OF CRYSTALLINE DEFECTS BY ION-BEAM TECHNIQUES. Brown, W. L. (Bell Telephone Labs., Inc., Murray Hill, NJ). pp 416-428 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

A summary is presented of current understanding of channelling methods for analysis of defects in crystalline solids. The methods are applicable at defect concentrations of the order of 1% and in layer thicknesses of the order of 1 μm. Consideration is given to the sensitivity and specificity that the methods provide. The significance of "flux peaking" in such studies and of single alignment-double alignment comparisons are discussed. (auth)

6449 ANNEALING BEHAVIOUR OF DISORDER DENSITY IN 1-MeV ZINC-IMPLANTED GALLIUM ARSENIDE BETWEEN 20 AND 1000°C. Guivarc'h, A.; Favennec, P. N.; Pelous, G. P. (Centre National d'Etudes des Telecommunications, Lannion, France). pp 429-437 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Channelling experiments with 1.5-MeV He$^+$ ions were carried out to study lattice damage of ⟨111⟩ GaAs slices, after 1-MeV zinc ion implantation. Implantations were performed at the temperature of liquid nitrogen with 10^{14} ions/cm^2 and 5×10^{14} Zn ions/cm^2. At 20°C an "amorphous" layer about 6500 Å thick, dependent on the dose, was found. Using a linear-scattering approximation to analyse the channelling results, the disorder spatial distribution against annealing temperature is noted. Above 700°C, the disorder density decreases very rapidly without change in its spatial distribution. An annealing at 950°C is necessary to recover lattice order. Van der Pauw–Hall measurements of carrier mobility and number in Zn-implanted layers as a function of annealing temperature are presented. A simple model taking into account the overlapping of disorder, carrier and implanted ion distributions, is presented to correlate the channelling and Hall results. (auth)

6450 IRRADIATION-INDUCED DEFECTS STUDIED BY THE CHANNELLING METHOD IN p- AND n-TYPE SILICON. Pabst, H. J.; Plamer, D. W. (Sussex Univ., Brighton, Eng.). pp 438-446 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

Single and double-alignment, proton-channelling backscattering measurements were made on samples of p- and n-type silicon at 80 and at 300°K after proton irradiation at successively higher doses. The probing proton beam was itself the damaging beam, the energy was 300 keV, and the irradiation doses extended up to about 5×10^{16} protons/cm^2 at well-controlled dose rates. The single- and double-alignment measurements were carried out simultaneously and used respectively for a ⟨110⟩ axis and two mutually perpendicular ⟨110⟩ axes. The experimental results are interpreted using a theoretical analysis of single-alignment and double-alignment scattering yields for low defect concentrations. The ratio of the changes in these yields depends on the location of the defect scattering centres, and by means of computer simulation calculations of the channelling and the blocking effect information about the location of defects has been obtained from experimental values of this ratio. The results are consistent with the presence of bond-centred or split interstitials for n-type silicon at 80°K and of lattice distortions around vacancy defects in the other cases. In p-type silicon the irradiation-induced changes in scattering yields were similar at 300 and 80°K, but the changes for n-type silicon were larger than this at 300°K and less at 80°K. (auth)

6451 ^{73}Ge 13.3-keV MOESSBAUER EFFECT AND ITS APPLICATIONS TO LATTICE-DEFECT STUDY IN SEMICONDUCTORS. Matsui, K. (Tohoku Univ., Sendai); Konno, O.; Ishino, S. pp 447-456 of Radiation Damage and Defects in Semiconductors. London; Inst. of Physics (1973).

From international conference on defects in semiconductors; Reading, UK (19 Jul 1972). See CONF-720713-.

The Moessbauer effect associated with the 13.3-keV E2 ($^5/_2{}^+$ to $^9/_2{}^+$) transition of ^{73}Ge was investigated for the ^{73}Ga parent embedded in germanium single crystals by making use of a photonuclear reaction ^{74}Ge (γ,p) ^{73}Ga. The sources are prepared by bombardments of germanium wafers with 50-MeV linac electrons partially converted to γ rays. The specimens are subsequently annealed at 510°C to remove primary damage. The Moessbauer effect measurements are made for Ge K x rays scattered from germanium powder to avoid the difficulties related to the high internal conversion coefficient of the 13.3-keV transition. Unresolved resonance effects were observed at 300°K. The resonance spectra are found to be Fermi level and temperature dependent. The spectra in n-type material do not depend very much on chemical dopant density, whereas they do in p-type material. Pattern changes which cannot be ascribed to Fermi level shifts alone have been observed in p-type material at 180°K. These results suggest that the 1.2-MeV β^- recoil of ^{73}Ga gives rise to interstitial germanium with an excited nucleus. Typical Moessbauer spectra expected for free, trapped, or converted interstitials are discussed in terms of crystal field approach. They indicate the possibilities of microscopic defect characterization by means of hyperfine interactions experienced by the narrow-line Moessbauer nuclide. (auth)

6452 CHARGE DIAGNOSTICS FOR ELECTRON-IRRADIATED POLYMER FOILS. Gross, B.; Sessler, G. M.; West, J. E. (Bell Laboratories, Murray Hill, New Jersey 07974). Appl. Phys. Lett. 22: No. 7, 315-316 (1 Apr 1973).

Polymer foils carrying thin vacuum-deposited electrodes on both surfaces are irradiated with nonpenetrating monoenergetic electron beams of various energies. Measurement of the currents and charges drawn from both electrodes and of the voltage buildup between the electrodes during and after irradiation allows one to determine charge storage parameters of such electrets. (auth)

6453 HIGH-ENERGY ELECTRON-BEAM DEPOSITION ONTO A HOT GRAPHITE SURFACE. Robin, James E. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91103); Srivastava, R. D. Appl. Phys. Lett. 22: No. 4, 153-153 (15 Feb 1973).

The momentum transfer and blow-off vapor yield resulting from the deposition of a pulsed high-power electron beam onto a plane graphite target with surface temperatures of 300°K and 5000 °K are examined experimentally. The results show that with identical electron beams the momentum transfer and vapor yield are between two and three times larger when irradiating the 5000 °K surface as compared with the 300 °K surface. (auth)

6454 ANNEALING OF RADIATION-INDUCED DEFECTS IN NEUTRON-IRRADIATED CRYSTALS OF LiF: Mg_2^+. Andreev, G. A. (Ioffe Inst. of Physics and Tech., Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 10, 1561-1564(Oct 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 10, 1774-1777(Oct 1972).

Results show that in lithium fluoride crystals with magnesium as impurity, irradiated in a reactor, the radiation defects are more stable than in a corresponding pure crystal. The activation energy of annealing the density changes has a maximum when plotted vs temperature. At 200 to 300°C, decomposition of solid solution apparently occurs simultaneously with annealing of the radiation damage. (auth)

6455 PHOTORADIATION EFFECT IN THE CREEP AND DURABILITY OF LOADED POLYMERS. Stepanov, V. F.; Vaisberg, S. E. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 208: No. 5, 1121-1122(11 Feb 1973). (In Russian).

The effects of sequential and simultaneous action of visible light and 1-MeV electron irradiation on the increase in deformations and on the creep rate of polycarbonate were observed. The samples were loaded so as to produce a stress of 3.5 kg/mm^2. Visible light did not increase creep of the polymer; however light simultaneously with electron bombardment, or directly after it, lead to a sharp acceleration of the radiation creep. These phenomena were noticed with samples of Lavsan, Capron, polycarbonate, polyvinyl chloride, cellulose triacetate, epoxide resin E-41, polyimide PM-1, and polyethylene. The effect was absent in samples of poly(methyl methacrylate), Teflon, polystyrene, polypropylene, and natural rubbers. (KSW)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstract 5769.

6456 (BNWL-SA-4059) APPLICATION OF GAMMA RAY SPECTROMETRY AS A SUPPLEMENTARY MIST TECHNIQUE. Oden, D. R.; Christensen, D. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). 1971. Contract AT(45-1)-1830. 36p. (CONF-710977-1). Dep. NTIS.

The determination of neutron exposure or fuel burnup by nondestructive gamma scanning techniques has the potential of being the only practical safeguards check against diversion of Pu during the time following discharge of fuel from a reactor until it is chemically processed. A basic description of the method and two research efforts which were performed at Battelle-Northwest are presented. (TFD)

6457 (INDC(NDS)-50/U+S) REQUEST LIST OF NUCLEAR DATA FOR SAFEGUARDS DEVELOPMENT PURPOSES AS SUBMITTED TO THE INTERNATIONAL ATOMIC ENERGY AGENCY BY MEMBER STATES. Byer, T. A. (comp. and ed.) (International Nuclear Data Committee). Mar 1973. 48p. Dep. NTIS (U. S. Sales Only) $4.50.

The request list from the USA, USSR, and the Federal Republic of Germany contains 124 items of nuclear data needed for the development of active and passive nondestructive assay of nuclear materials. (TFD)

6458 (LA-5197-PR) NUCLEAR ANALYSIS RESEARCH AND DEVELOPMENT. Program Status Report, September-December 1972. (Los Alamos Scientific Lab., N. Mex.). Mar 1973. Contract W-7405-eng-36. 32p. Dep. NTIS $3.00.

The status of the nondestructive assay R & D program of the LASL Nuclear Analysis Research Group, A-1, covering the period from Sept. 1, 1972 through Dec. 31, 1972 is discussed. The wide-ranging content of this program status report includes the following subjects: nondestructive assay of nuclear fuels and fabricated fuel components; isotopic source systems using α, n and γ, n neutron interrogation; passive assay applications and results; detector and instrumentation development; and materials identification and analysis with stopped muons. (auth)

6459 (RT/GIU-(73)1) ITALIAN REGULATIONS FOR THE HOLDING, USE OF AND TRADE IN RADIOACTIVE SUBSTANCES. Nocera, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 30 Jan 1973. 53p. (In Italian). Dep. NTIS (U. S. Sales Only) $4.75.

A survey is presented of existing Italian regulations for possession, use, and trade in radioactive substances. Obligations deriving from the various nuclear laws are commented on, ranging from the first Italian law on peaceful uses of nuclear energy (No. 1860 of 1962) to that on radiological protection (No. 185 of 1964) and various decrees implementing the said laws as of December 1972. The survey also deals with a number of ministerial circulars containing additional directions or explanations for compliance with the law. Penalties established for the disregard of the above provisions are dealt with. Three tables arranged so as to provide a quick consultation of the regulations considered are attached. (auth)

6460 INTERNATIONAL SAFEGUARDS AND NUCLEAR INDUSTRY. Willrich, M. (Ed.). Baltimore; John Hopkins University Press (1973). 315p. $11.50.

The historical evolution of international safeguards is reviewed by considering the need for international safeguards and the growth of the worldwide nuclear industry. IAEA and national safeguards against nuclear materials diversion are discussed as well as the possibilities for nuclear materials diversion by national governmental and by non-governmental organizations. The industrial and political implications of safeguards are described. Appendixes are included on: Treaty on the Non-Proliferation of Nuclear Weapons; IAEA agreements; excerpts from the statute of the IAEA; and participation in safeguards agreements as of June 30, 1972. Supplementary material includes biographical notes on the chapter authors, membership list of the American Society of International Law Panel on Nuclear Energy and World Order, and a subject index. (LCL)

6461 PREVENTING NUCLEAR THEFT: GUIDELINES FOR INDUSTRY AND GOVERNMENT. Leachman, R. B.; Althoff, P. (Eds.). Praeger Special Studies in International Politics and Public Affairs. New York; Praeger Publishers (1972). 403p. (CONF-711034-). $19.50.

From symposium on implementing nuclear safeguards; Manhattan, Kansas, USA (25 Oct 1971).

The significance and development of domestic and international safeguards programs and the problems associated with keeping vital nuclear materials in the right hands are discussed in detail. Information is included on the legal, sociological, economic, technical, and political aspects of safeguards systems and of their implementation. Nuclear detection methods and industrial safeguards problems through the fuel cycle are described. Methods for optimizing inspections by studying safeguards as a systems problem and by applying the theory of games to optimization are proposed. (LCL)

Disposal and Storage

Refer also to abstracts 5532–5535, 5545, 5560, 5850, and 6065.

6462 (KFK-1585) DISPOSAL OF RADIOACTIVE WASTE. Annual Report, 1971. Diefenbacher, W.; Krause, H.; Schuchardt, M. C.; Albrecht, E.; Kolditz, H.; Thielemann, K.; Borchert, H.; Duerr, K.; Klarr, K.; Kuehn, K.; Staupendahl, G. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (West Germany); Gesellschaft fuer Strahlen- und Umweltforschung M.B.H., Munich (West Germany)). Jul 1972. 39p. (In German). (GSF-T-42). Dep. NTIS (U.S. Sales Only) $4.00.

This report is a joint effort of Gesellschaft für Strahlen- und Umweltforschung mbH München and Gesellschaft für Kernforschung mbH Karlsruhe presenting a survey of the work performed in 1971 in the field of disposal of radioactive wastes. The mining and construction work carried out both underground and above ground at the Asse Salt Mine near Remlingen is discussed. The work was done for maintenance and repair as well for expansion of operation in accordance with the future purposes of the facility. In the period under review long-time disposal of low level radioactive wastes was started on the 750 m level. The technical equipment for the test disposal of intermediate level wastes on the 490 m level was completed and checked in test operation. The state of research in the fields of rock mechanics, geology, and hydrology is summarized. Plans for new techniques of storage are discussed. (auth)

6463 DISPOSAL OF RADIOACTIVE WASTE. Proceedings of the Information Meeting, Paris, April 12-14, 1972. Paris; Organization for Economic Co-operation and Development (1972). 294p. (In French and English). (CONF-720453-).

From meeting on disposal of radioactive waste; Paris, France (12 Apr 1972).

Separate abstracts were prepared for 16 of the 17 papers presented at the conference. The other paper discusses the role of ICRP and the relationship of ICRP to the international agencies. (ERB)

For abstracts of individual papers see: 5410, 5532–5535, 5563, 5569, 5570, 6065, and 6464–6470.

6464 ORIGIN AND NATURE OF RADIOACTIVE WASTES. Relative Importance of the Different Sources. Olivier, J. P. (European Nuclear Energy Agency, Paris). pp 13-29 of Disposal of Radioactive Waste. Paris; Organization for Economic Co-operation and Development (1972). (In French and English)

From meeting on disposal of radioactive waste; Paris, France (12 Apr 1972). See CONF-720453-.

Radioactive wastes make up a very heterogeneous collection of products whose common property is to emit ionizing radiations. Radioactive materials originate from two fundamental processes (nuclear fission and neutron activation) and will themselves form wastes or will subsequently contaminate various products that should then be considered as radioactive waste. Radioactive wastes may be classified according to different criteria: physical and chemical properties, type of radiation emitted, composition, and degree of contamination. Detailed data are given concerning radioactive waste production from radioisotope preparation and applications, as well as in nuclear power generation. This latter application is responsible for practically all radioactive waste production and a description of the wastes produced at the different stages of the nuclear fuel cycle brings to light the specific part played in this respect by fuel reprocessing plants. Fission products, unspent uranium, and the plutonium formed in the fuel by neutron bombardment of uranium-238 are in fact separated in such plants, the results being: concentrated fission-product solutions, liquid effluents contaminated by fission and activation products, gaseous effluents contaminated by gaseous or volatile fission products (krypton, xenon, iodine, tritium) and solid wastes, contaminated to varying degrees by fission and activation products, and also by transuranium elements such as plutonium. Estimates, taking account of the predictable development of nuclear energy, are made for the principal stages of the nuclear fuel cycle. (ERB)

6465 METHOD OF DISCHARGE TO AIR AND CONTROL OF RELEASE. Method of Reduction of Discharges and Control of Air Cleaning Facilities. Pradel, J. (CEN, Fontenay-aux-Roses, France). pp 137-144 of Disposal of Radioactive Waste. Paris; Organisation for Economic Co-operation and Development (1972). (In French and English).

From meeting on disposal of radioactive waste; Paris, France (12 Apr 1972). See CONF-720453–.

Methods of discharge of radioactive waste into the atmosphere are discussed. The wastes arise mainly from continuously emitting point sources, and atmospheric dilution is used to disperse gas and particles through a high stack. Control measures include stack sampling, air sampling from points following air cleaning devices, and radiological monitoring of the environment in the vicinity of release sources. Methods of reduction of discharges include primarily the systematic limitation of pollution sources and elimination of causes of accidents. This includes the use of adequate containment facilities and equipment for cleaning of air and trapping of gases and vapors. The control of air cleaning facilities in order to maintain high efficiency is discussed. (ERB)

6466 METHODS OF DISPOSAL OF RADIOACTIVE WASTES INTO WATER AND THEIR CONTROL. Schwibach, J. (Bundesgesundheitsamt, Neuherberg, Ger.). pp 145-156 of Disposal of Radioactive Waste. Paris; Organization for Economic Cooperation and Development (1972). (In French and English).

From meeting on disposal of radioactive waste; Paris, France (12 Apr 1972). See CONF-720453–.

Following a brief discussion of the role of the health physicist and the environmentalist in the control of radioactive waste disposal into water, the subject of disposal and its control is discussed under the following headings: disposal of radioactive waste water from nuclear power stations in the Federal Republic of Germany; considerations underlying current licensing in the Federal Republic of Germany; new problems arising from the use of cooling towers; zero release design of nuclear power stations; and control of the disposal of radioactive waste water. The processing of spent fuel still poses special problems. Up to now, treatment and disposal methods applied by nuclear power stations will satisfy every public health demand. (ERB)

6467 METHODS OF STORAGE AND DISPOSAL OF RADIOACTIVE WASTE ON THE SURFACE OR UNDERGROUND. Krause, H. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). pp 157-167 of Disposal of Radioactive Waste. Paris; Organization for Economic Co-operation and Development (1972). (In French and English).

From meeting on disposal of radioactive waste; Paris, France (12 Apr 1972). See CONF-720453–.

Much progress has been achieved over the past few years regarding the final disposal of radioactive wastes in deep formations. A number of processes have graduated from the stage of laboratory trials to that of technical testing or industrial application. It may therefore be expected that large amounts of radioactive wastes will soon be disposed of on a routine basis in many places. Present knowledge indicates that low to intermediate level liquid wastes may be disposed of at suitable sites by hydraulic fracturing or deep well injection. Storage of low and intermediate level solid wastes in basement rock and in the ground is possible where local conditions are favorable. Salt formations are suitable for the disposal of all kinds of wastes except high level liquids. In view of the progress made in the final disposal of radioactive wastes it is certain that further development of nuclear technology will not be restricted by disposal problems and that his new branch of technology will not generate health hazards to man. (auth)

6468 PRINCIPLES GOVERNING AUTHORIZATIONS FOR DISPOSAL. Chanteur, J. (Service Central de Protection Contre les Rayonnements Ionisants, Le Vesinet, France). pp 171-181 of Disposal of Radioactive Wastes. Paris; Organization for Economic Co-operation and Development (1972). (In French and English).

From meeting on disposal of radioactive waste; Paris, France (12 Apr 1972). See CONF-720453–.

Legal provisions to clearly determine the liability and obligations of operators regarding the disposal of radioactive wastes are proposed. Using the French regulatory text as a basis, the provisions include: the system of authorization and scope of application; conditions of authorization and procedure; and implementation. (ERB)

6469 ADMINISTRATIVE AND LEGAL CONTROL OF THE RELEASE OF WASTES, INCLUDING MONITORING. Kenny, A. W. (Dept. of the Environment, London). pp 183-189 of Disposal of Radioactive Waste. Paris; Organization for Economic Cooperation and Development (1972). (In French and English).

From meeting on disposal of radioactive waste; Paris, France (12 Apr 1972). See CONF-720453–.

The principles of control of radioactive waste disposal in the United Kingdom are discussed, and the legalization required for implementation of these principles is proposed. Monitoring methods are proposed that would provide for monitoring of large discharges before discharge and monitoring of the environment directly in the case of smaller discharges. The control of solid wastes is a more difficult matter because they do not disperse readily in the environment. (ERB)

6470 PRESENT SITUATION AND FUTURE PROSPECTS REGARDING THE PROBLEMS RAISED BY RADIOACTIVE WASTES. Sousselier, Y. (CEA, Chatillon-sous-Bagneux, France). pp 193-203 of Disposal of Radioactive Waste. Paris; Organization for Economic Co-operation and Development (1972). (In French and English).

From meeting on disposal of radioactive waste; Paris, France (12 Apr 1972). See CONF-720453–.

At present, radioactive wastes do not raise serious conditioning or storage problems mainly because the quantities produced are small. However, the extremely rapid increase in the number of nuclear power stations in operation during the coming years will result in a considerable growth in volume of the wastes to be stored and mainly, in the amount of contained radioactivity. It will then be necessary to determine the suitability of storage sites according to criteria based, in particular, on the half-lives of the contained radionuclides. Although surface storage methods for low-level wastes containing only short-lived radionuclides will continue to be used, appropriate geological formations (salt, limestone, etc.) will have to be selected for the storage of very long-lived radionuclides such as plutonium. It will be possible to bury short-lived but highly active wastes either very deep underground or near the surface, in specially designed bunkers, but always after solidification. Thorough studies must continue on elimination of krypton from gas released by reprocessing plants, or on the safe storage of tritiated effluents. The main obstacle likely to be encountered when implementing this policy will be the local population's opposition to the implantation of ultimate storage centers. (ERB)

6471 METHOD FOR UNDERGROUND DISPOSAL OF RADIOACTIVE WASTE. Stogner, J. M. (to Halliburton Co.). British Patent 1,309,281. 7 Mar 1973. Filed date 26 May 1970. 6p.

A method is described for disposing of solid radioactive particulate material. Dry cementitious material is mixed with fluid comprising water and < 5% of other liquids, such as oils, that do not react with hydraulic cement, the mixture is agitated, and the radioactive waste material is injected while still agitated, to uniformly disperse the particles. The radioactive mixture is pumped to a well bore, while maintaining a continuous phase in it, and sufficient pressure is applied to cause well formation fracture and force the mixture into the fracture. The fracture is propped open by the solid radioactive waste material, which is allowed to solidify within the propped structure. A cementitious material slurry free of radioactive material may be pumped into the well bore and allowed to harden to form a seal for the radioactive mixture in the fracture. Several flow modifications to this basic process are also described. (UK)

6472 POSSIBILITY OF POLLUTION OF UNDERGROUND AND SURFACE WATERS FROM RADIOACTIVE DISCHARGE FROM A NUCLEAR FUEL REPROCESSING PLANT. Lenzi, G. (CNEN, Casaccia, Italy); Cassano, G. Ing. Sanit.; No. 1, 7-18 (1972). (In Italian). (RT/PROT–(72)35).

The general criteria for the study of underground waters radioactive contamination in the sites of nuclear fuel reprocessing are examined. As example the general situation of CRN of CNEN in Trisaia is studied, and the following arguments are described: stratigraphy and hydrogeology of the sites; and analysis on representative soil samples for determination of distribution and dispersion coefficients. Afterwards, the hypothesis of ground water accidental contamination by 1000 Ci of fission products is considered, the dispersion in time and space is also calculated. (auth)

Handling Equipment and Procedures

6473 (APDA-M-72-133) DESCRIPTION OF A C-SCAN DRIVE SYSTEM FOR AN UNDER SODIUM SCANNER. Toth,

W. L.; Matte, J. III (Atomic Power Development Associates, Inc., Detroit, Mich.). Aug 1972. 8p.

A C-scan drive system for an under-sodium ultrasonic scanner is described. Drawings are included. (WHK)

6474 RADIATION DOCKING DEVICE. Carl, W.; Schaaf, N. G.; Schoemann, D. (Roswell Park Memorial Inst., Buffalo). J. Prosth. Dent.; 29: No. 1, 97-99(Jan 1973).

A patient that had experienced several surgical excisions of adenocystic carcinomas had a recurrent lesion that was considered inoperable, which left radiation treatment as the only alternative. A radiation docking device constructed of cold-curing acrylic is described. The purpose of the device was (1) to provide a means for returning the cone of the radiation machine to the same position and direction, (2) to maintain an opening during treatment, and (3) to keep buccal tissue from the field of radiation. (TFD)

6475 MOBILE DISPENSER FOR RADIOACTIVE SOURCES. Jones, J. C.; Howes, J. W.; Stanley, D. F. (to National Research Development Corp.). British Patent 1,308,041. 28 Feb 1973. Filed date 26 Nov 1968. 7p.

A dispenser is described for dispensing radioactive sources under shielded conditions, of particular application to tumors of the uterine cervix or neck of the uterus. The source employed is ^{137}Cs. By using Cs instead of Ra it has been possible to design a relatively small mobile dispenser that can be located in the operating theatre so that the radiotherapist can readily be supplied with his exact requirements as regards type of applicator during the course of work on the patient in the theatre. A magazine is provided having a number of locations for storage of sources of different strengths. The magazine is enclosed in a lead or equivalent shielding chamber, and is provided with an ejector mechanism. A loading assembly houses an applicator to receive the ejected source, together with a selector mechanism and counter mechanism. Constructional details are given. (UK)

6476 REMOTELY CONTROLLED AFTER-LOADING APPARATUS. Yamashita, H. (Keio Univ., Tokyo); Makino, S. Australas. Radiol.; 16: No. 4, 421-426(Dec 1972).

The sections of the apparatus are described. Sources are ^{137}Cs or ^{60}Co. Dose distribution, applicators, source container, source driving mechanism, guiding tubes, ceiling suspension, control cabinet and treatment couch are described. Special safety precautions are taken. (AT)

Transportation

Refer also to abstract 7503.

6477 PROBLEM OF SHIELDING DESIGN. Tamura, K. (Kimura Kakoki Co. Ltd., Amagasaki, Japan). Genshiryoku Kogyo; 18: No. 12, 20-23(Dec 1972). (In Japanese).

Spent fuel transport casks must perform the functions of containing the spent fuel, radiation shielding, and maintaining subcriticality. Shielding is most important. Besides the radiation shielding, shielding design is also concerned with cask strength, heat removal, anti-shock resistance, and fire-proofing. Problems in the shielding of gamma-rays and neutrons, structural materials, cask strength, etc., are reviewed. Water, boron, paraffin, lead, iron, and depleted uranium, are used as shielding materials. Lead has the least advantage of easy fabrication and shock-absorbency. Depleted uranium is advantageous in fire-proofing and high shielding effect, while there is the problem of reaction with other materials.NFS-M 1000, IF 300, and the casks for the JMTR fuel are described as examples of currently used casks. (JA)

6478 MANUFACTURE OF TRANSPORT CONTAINERS FOR SPENT FUELS. Problem of the Mechanical Strength. Onodera, A. (Hitachi Shipbuilding and Engineering Co. Ltd., Osaka). Genshiryoku Kogyo; 18: No. 12, 10-14(Dec 1972). (In Japanese).

In Japan, power plants with light-water reactors are being put into operation, therefore the transport of spent fuel to fuel reprocessing plants becomes highly important. Containers for spent fuel transport are discussed in respect to safety features of the containers, strength design for the containers, evaluation of container deformation due to fall impact, effect of shock absorbers, container strength against physical penetration, and technological problems in container manufacture. On the fall impact and resultant deformation, results of tests with reduced-scale models are given for both spherical and cylindrical containers. By using shock absorbers, the deformation can be greatly reduced. For the manufacture of containers, problems of casting lead as shielding and its quality control are especially treated. (JA)

6479 EXPERIENCES WITH THE TRANSPORTS OF FUEL FOR NUCLEAR POWER STATIONS IN THE WORLD. Kos, M. (Litostroj, Ljubljana, Yugoslavia). Strojniski Vestn.; 17: No. 6, 217-220(1971). (In Slovene).

A survey of the systems and the organizations for the transport of irradiated and unirradiated fuels in Great Britain and in some other countries is presented. Experiences that have been gathered during transportation and necessary improvements and accomplishments of equipment and devices for the transport are described. (Bull. Sci., Sect. A.)

6480 HEAT TRANSFER AND THERMAL TESTING OF TRANSPORT PACKING FOR SPENT FUELS IN ATOMIC POWER STATIONS. Kos, M. (Litostroj, Ljubljana, Yugoslavia). Strojniski Vestn.; 17: No. 4-5, 163-166(1971). (In Slovene).

Transport of spent fuel from nuclear power stations is combined with the problem of heat transfer which is developed by the fuel. For projecting the transport packings and packages, the cooling system has to be designed in such a way that the temperature does not exceed a critical value. (Bull. Sci., Sect. A.)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstracts 5462, 5486, 6720, and 7013.

6481 (LA-UR-73-483) MINICOMPUTER APPLICATIONS AT LAMPF. Gore, R. A.; Machen, D. R. (Los Alamos Scientific Lab., N. Mex.). 1973. 7p. (CONF-730508-3). Dep. NTIS $3.00.

From 6th conference on minicomputers and their applications; Honolulu, Hawaii, USA (2 May 1973).

A substantial number of the world's research laboratories in low, medium, and high energy physics have been among the earliest users of minicomputer data acquisition and control systems. A decade ago, the commercially available minicomputers were put to use gathering data from physics experiments using particle beams from accelerators. Early in 1965, engineers and physicists at several laboratories installed minicomputers to handle a small portion of the beam transport control problem for accelerators. Since that time, the use of minicomputers for special instrumentation, data acquisition, and supervisory control has mushroomed throughout the accelerator world. Being no exception to this trend, engineers and physicists at LAMPF have made a practice of applying minicomputer systems to assist in solving numerous instrumentation and control problems. Current applications of Nova and Super Nova computers to proton beam diagnostics, experimental interface development and evaluation, accelerator structure tuning, magnet field mapping, and ion source operation are described. Also, applications of PDP-11/05, /10, /20, and /45 computers to nuclear instrumentation testing, development, and data handling are presented. (auth)

6482 (RHEL/R-252) PROCEEDINGS OF MEETING OF THE DARESBURY–RUTHERFORD ACCELERATOR WORKING PARTY HELD AT THE COSENER'S HOUSE: ABINGDON, 16-17 DECEMBER 1971. Gray, D. A. (ed.) (Rutherford High Energy Lab., Chilton (England)). Apr 1972. 80p. (CONF-711224-). Dep. NTIS (U. S. Sales Only) $6.00. UK 85 pence.

Separate abstracts were prepared for the seven papers presented. (WHK)

For abstracts of individual papers see: 6483–6488 and 6518.

6483 (RHEL/R-252, pp 2-17) SUPERCONDUCTING PROTON SYNCHROTRONS. King, N. M. (Rutherford High Energy Lab., Chilton, Eng.). Apr 1972.

From meeting of the Daresbury–Rutherford accelerator working party; Abingdon, England (16 Dec 1971).

Results of an early study for the construction of a superconducting synchrotron in the UK are outlined. Some aspects of superconducting magnet design, apertures for 1000 GeV machines, a proposed UK design for 80 GeV, and rough cost estimates are discussed. (WHK)

6484 (RHEL/R-252, pp 18-20) CONVENTIONAL ELECTRON SYNCHROTRONS. Saxon, G. (Daresbury Nuclear Physics Lab., Eng.). Apr 1972.

From meeting of the Daresbury–Rutherford accelerator working party; Abingdon, England (16 Dec 1971).

Information provided by the NINA Booster design study which is relevant to other future electron synchrotrons is outlined. Also, comments are made on design problems such as aperture, radiation anti-damping, and extraction from NINA in six turns. (WHK)

6485 (RHEL/R-252, pp 21-25) SUPERCONDUCTING ELECTRON LINEAR ACCELERATORS. Carne, A. (Rutherford High Energy Lab., Chilton, Eng.). Apr 1972.

From meeting of the Daresbury–Rutherford accelerator working party; Abingdon, England (16 Dec 1971).

An equation for estimating the cost of superconducting electron linacs is given and discussed. (WHK)

6486 (RHEL/R-252, pp 26-33) SUPERCONDUCTING ELECTRON SYNCHROTRONS AND MESOTRONS. Saxon, G. (Daresbury Nuclear Physics Lab., Eng.). Apr 1972.

From meeting of the Daresbury–Rutherford accelerator working party; Abingdon, England (16 Dec 1971).

Advantages and technical problems with superconducting synchrotrons are listed. Also, the main features, design problems, and estimated cost of a 40 GeV electron mesotron (meso = multiple energy, separated orbit) are briefly discussed. (WHK)

6487 (RHEL/R-252, pp 44-54) REVIEW OF MEDICAL USES OF ACCELERATORS. Perry, D. R. (Rutherford High Energy Lab., Chilton, Eng.). Apr 1972.

From meeting of the Daresbury–Rutherford accelerator working party; Abingdon, England (16 Dec 1971).

Isotope production, radiotherapy, oxygen enhancement, requirements for radiotherapy beams, and radiation types are briefly discussed. (WHK)

6488 (RHEL/R-252, pp 55-72) HEAVY ION ACCELERATORS. Bennett, J. R. J. (Rutherford High Energy Lab., Chilton, Eng.). Apr 1972.

From meeting of the Daresbury–Rutherford accelerator working party; Abingdon, England (16 Dec 1971).

The fields of work which can be accomplished with heavy ions are briefly listed, and the different accelerators for heavy ion acceleration are discussed. (WHK)

6489 (TID-26315) NONDESTRUCTIVE MEASUREMENT OF PHASE-SPACE PROPERTIES OF THE 50-MeV PROTON BEAM BETWEEN THE LINAC AND THE ZGS. Concaildi, G.; George, R.; Marcowitz, S.; Sanders, R. (Argonne National Lab., Ill.). 3 Dec 1969. 9p. Dep. NTIS $3.00.

Nondestructive measurements of the phase-space properties of the 50-MeV proton beam, between the ANL–ZGS linac and main ring using the ionization chamber PAPS (position and profile system) and computer programs developed at ANL are presented and discussed. (WHK)

6490 30 keV INSTRUMENT FOR ION SURFACE INTERACTIONS STUDIES. Livesey, R. G. (Edwards High Vacuum Ltd., Crawley, Eng.). Vacuum; 22: No. 11, 595-597(Nov 1972).

A small ion beam system has been designed for experimental work in the energy range up to 30 keV. After a description of the system some details of experimental work on blocking, sputtering, and backscattering ion energy spectra are given. (auth)

6491 PRODUCTION OF RADIONUCLIDE BY USING A COMPACT AVF CYCLOTRON. Watanabe, N. (Tokyo Univ.). Proc. Jap. Conf. Radioisotop.; No. 10, 480-482(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Compact cyclotrons are useful in the fields of biology and medicine because of low cost and easy maintenance and because the radioisotopes produced are mostly neutron-deficient nuclides. The factors involved in cyclotron design are described, such as beam energy and beam intensity. Radioisotope (RI) yield generally increases with the beam energy. Buildings or structures necessary for the installation of the cyclotrons vary with the magnitude of RI production, performance of the cyclotrons, geographical conditions, and budget. Configuration and construction of the respective components, such as cyclotron rooms and target rooms, and also staffing, are explained. Actually, more important problems encountered in the RI production with cyclotrons are choice of targets, target cooling, and recovery of the radioisotopes produced. These aspects are described for both internal and external targets. In the latter case, foils are usually used to degrade energy or to keep in vacuum. (JA)

6492 SOME MEDICAL APPLICATIONS OF ACCELERATORS. Rosen, L. (Los Alamos Scientific Lab., NM). Contract W-7405-ENG-36. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 10-23(Feb 1973).

The present uses of accelerators in nuclear medicine and radiation therapy are summarized. Attention is called to the widespread use of these devices for production of radioisotopes for diagnostic purposes and of x rays for treatment of cancer. Developments presently underway to make use of high-energy heavy nuclear particles for both isotope production and therapy are discussed and an overview is presented of one of a new family of accelerators nearing completion. In view of the large fraction of the total population who stand to benefit from better diagnostic and therapy modalities, the question is posed whether more adequate resources should not be made available for improving diagnostic and therapeutic capabilities while minimizing radiation dose to the patient. (auth)

6493 LINEAR ACCELERATOR CAVITY FIELD CALCULATION BY THE FINITE ELEMENT METHOD. Konrad, A. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 802-808(Feb 1973).

The design of linear accelerator (linac) cavities necessitates the field solution of axisymmetric electromagnetic resonators. Mathematically this involves the solution of the one-component vector Helmholtz equation in cylindrical coordinates subject to boundary conditions which are dictated by the physics of the electromagnetic field problem. It is shown how the high-order polynomial, triangular, finite element method can be applied to field calculation in linac cavities of arbitrary longitudinal cross section. (auth)

Auxiliaries and Components

Refer also to abstracts 5512 and 7211.

6494 (BNL-17767) EQUIVALENT CIRCUIT ANALYSIS OF MULTIPERIODIC STRUCTURES. Bauer, W. (Brookhaven National Lab., Upton, N. Y.). 20 Feb 1973. 26p. Dep. NTIS $3.50.

The effects of fabricating tolerances on rf joints in multiperiodic structures are analyzed by using an equivalent circuit description. The calculations demonstrate that the currents at the joints between single sections of a multiperiodic structure are of the same order of magnitude as in the $\pi/2$-mode structure. (auth)

6495 (CERN/ECFA-72/4(Vol.2), pp 225-248) GESSS REPORT. Heinz, W. (Kernforschungszentrum, Karlsruhe, Ger.). Jan 1973.

In ECFA: 300 GeV Working Group.

Progress of the GESSS Collaboration (Group for European Superconducting Synchrotron Studies) in research on pulsed superconducting magnets and their application in future accelerators, especially in a possible completion of the European 300-GeV machine with superconducting magnets or a conversion of this machine to a fully superconducting one, is described. Superconducting magnet development, magnet power supplies, and magnet cryostat and refrigeration system are discussed. (WHK)

6496 (CONF-730518-1) HALF-VALUE THICKNESS MEASUREMENTS OF ORDINARY CONCRETE FOR NEUTRONS FROM CYCLOTRON TARGETS. Butler, H. M.; Wallace, K. M.; Fulmer, C. B. (Oak Ridge National Lab., Tenn.). 1973. 12p. Dep. NTIS $3.00.

From AIHA conference; Boston, Massachusetts, USA (20 May 1973).

Knowledge of half-value thicknesses of shielding used at a facility can be valuable information for the saving of both money and space as it may sometimes be more practical to use a modest permanent shield that meets the requirements most of the time and use administrative control and local shielding around the target when target and beam conditions require it. Measurements of radiation leakage were made on a thin (80 cm) concrete block wall that was erected in one of the target rooms being modified at ORIC. (TFD)

6497 (RHEL/R-258) INDIRECT COOLING OF A SUPERCONDUCTING MAGNET USING SUPERCRITICAL HELIUM. Bailey, R. L.; Colyer, B.; Homer, G. J. (Rutherford High Energy Lab., Chilton (England)). Dec 1972. 34p. Dep. NTIS (U. S. Sales Only) $3.75. UK 40 pence.

A dc superconducting quadrupole magnet was cooled to 4.36°K. A low temperature bath was situated several feet away from the magnet, and the two were connected by a closed system circulating supercritical helium as a heat exchange medium. At temperatures below about 6°K two phase helium was circulated in preference to supercritical helium. The magnet was energized up to its quench current several times and the cooling system dealt safely and efficiently with the resulting releases of energy. The magnet current reached 92% of the short sample value at 4.4°K. A system of this type is considered suitable for cooling dc beam line elements. (auth)

6498 (SLA-73-214) DEVELOPMENT OF A ROGOWSKI FARADAY CUP WITH 2.5 NANOSECOND RESPONSE TIME. McArthur, D. A. (Sandia Labs., Albuquerque, N. MEX). May 1973. 20p. Dep. NTIS $3.00.

The design and calibration of a Faraday cup which uses a Rogowski coil to read out the current are described for measuring the large electron beam currents produced Nereus, REBA, SLIM, and Hydra electron beam machines at Sandia. The cup is easier to construct than a resistive-foil Faraday cup, has comparable frequency response, and is expected to be more resistant to damage by high-energy electron beams. The theory of the high-frequency response of the cup is given and compared to experiment. (auth)

6499 SCANNING SYSTEM FOR THE BEAM ENERGY OF AN ACCELERATOR. Afanas'ev, M. I.; Bortnyanskii, A. L.; Graevskii, A. I.; Firsov, I. L. pp 221-225 of Prikladnaya Yadernaya Spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

6500 PROTON METER FOR NAL EXTERNAL BEAM LINES. Kerns, C. R. (National Accelerator Lab., Batavia, IL). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 204-208(Feb 1973).

Accurate beam intensity and total charge per accelerator pulse are important data for a number of experiments performed at NAL. The beam-current transformer and its electronics are operable in a beam intensity of 10^{10} protons, or more, delivered within a time interval of 100 μs. Special features of the design include both analog and digital outputs. The beam toroid is completely external to the vacuum pipe, giving optimum vacuum conditions. In situ test-signal injection and toroidal-core degaussing are incorporated. (auth)

6501 AUTOMATIC SELECTION OF FLUX DENSITY IN AN NMR CONTROLLED DC ELECTROMAGNET. Starkey, J. R. (Atomic Energy Board, Pretoria). Nucl. Instrum. Methods; 109: No. 2, 365-370(1973).

A system is described which enables one to establish a desired flux density by merely dialling the corresponding proton NMR frequency on thumbwheel switches. Both the oscillator frequency and the magnet current are automatically controlled to establish and maintain the nuclear resonance condition. The system controls the analyzing magnet of the Van de Graaff accelerator operated by the South African Atomic Energy Board. (auth)

6502 CORRECTION TO ELECTRON BEAM MONITOR PAPERS. Pruitt, J. S. (National Bureau of Standards, Washington, DC). Nucl. Instrum. Methods; 109: No. 2, 393-395(1973).

Two mistakes have been found in previously published papers about the electron beam monitor system of the NBS Linac. They invalidate the previously proposed explanation of the change in the measured Faraday cup error when vacuum foils are introduced into the beam line. When these mistakes are corrected, it is found that the generation of secondary electrons by Moeller scatter in the vacuum foils accounts for only about one third of the observed change, rather than all of it, as originally claimed. Additional experiments at 50 MeV have shown that the observed change is a non-linear function of foil thickness, and that the beam transmitted by the foils includes electrons with energies as small as 0.3 MeV. Electrons with this low an energy could not have been generated by Moeller scattering and must be the product of multiple processes in the foils. (auth)

Ion Sources and Injection and Extraction Systems

Refer also to abstract 7162.

6503 (JINR-P9-6973) SLOW EXTRACTION OF THE BEAM FROM THE JINR SYNCHROPHASOTRON (ADJUSTMENT AND STUDY OF THE SYSTEM). Vasilishin, B. V.; Volkov, V. I.; Zinov'ev, L. P.; Issinskii, I. B.; Kalenov, S. V.; Novikov, S. A.; Omel'chenko, B. D.; Pavlov, N. I.; Sikolenko, V. F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Operation of the slow extraction system, based on the use of the resonance $\nu_x = 2/3$, is described. The characteristics of the system units and the scheme of the extracted beam current stabilization are given. The results of the experimental investigation of some extracted beam parameters are presented. The extraction efficiency is $(94 \pm 0.5)\%$. (auth)

6504 DEFLECTOR AND DEFLECTOR GENERATOR OF A SYSTEM FOR ONE-TURN EXTRACTION OF PROTONS FROM THE BOOSTER OF A PROTON SYNCHROTRON. Vizir, V. A.; Vodop'yanov, F. A.; Orel, V. P.; Chuchalin, I. P. (Tomsk Polytechnic Inst., USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 985-987(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 18-21(1972).

Different versions of the deflectors and deflector-generator circuits for one-turn extraction of particles from the booster of a proton synchrotron are considered. A new deflector-generator circuit is proposed that has certain advantages over the ones used previously. A model of a deflector and generator extracting protons from the booster of the 1000-GeV cybernetic accelerator is described. (auth)

6505 USE OF THE INJECTED BEAM TO SYNCHRONIZE SYSTEMS THAT INJECT THE BEAM INTO A PROTON SYNCHROTRON. Gertsev, K. F.; Ermolaev, A. D.; Zaitsev, V. I. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 983-984(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 17-18(1972).

The procedure and equipment for synchronizing systems for injecting a beam into a synchrotron are described. The instant of trip-out of the voltage across the deflecting plates of the injection system is locked to the phase of the accelerating voltage, as a result of which beam losses associated with the finiteness of the time required to remove the voltage from the deflecting plates are eliminated. The procedure allows the filling of all of the separatrices of the phase motion of the particles to be achieved. (auth)

6506 FORMATION OF NEUTRALS IN ION BEAMS ACCELERATED ON A CYCLOTRON. Slyusarenko, L. I.; Tokarevskii, V. V. (Inst. of Nuclear Research, Kiev). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 991-993(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 24-25(1972).

The charge exchange (including neutralization) of ions during the process of acceleration or transport along an ion duct may lead to considerable loss in intensity and may likewise affect the accuracy with which the ion current is measured. An experimental installation is described for measurement of the intensity of the neutral component in ion beams. Estimates of the cross section for the production of neutrals in H_2^+, D^+, and He^{++} beams are presented for passage through a remanent gas. (auth)

6507 METHOD FOR EFFECTING NUCLEAR POLARIZATION OF A BEAM OF ATOMS. von Ehrenstein, D. (to United States Atomic Energy Commission). U. S. Patent 3,723,741. 27 Mar 1973. Filed date 1 Sep 1971. 7p.

A beam of atoms is passed through a magnetically saturated monocrystalline material to effect a charge-transfer reaction between the material and the atomic beam. The atomic beam is then sequentially passed through a first strong magnetic field region shaped decreasing from maximum field to zero field, a zero magnetic field region, and a second strong magnetic field region opposite in polarity to the first strong magnetic field region and shaped from zero field to maximum field to effect nuclear polarization of the atomic beam. (Official Gazette)

Ion Optics and Field Calculations

6508 (JINR-P9-6983) FORMATION OF THE MAGNETIC FIELD OF ACCELERATING UNIT IN THE MODEL OF COLLECTIVE LINEAR ACCELERATOR. Ivanov, G. A.; Mamonov, V. N.; Svetov, L. V. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Problems are considered connected with the formation of the magnetic field of the accelerating unit using the solenoid and several systems of the gradient coils. The results of calculation of the magnetic field of the leading solenoid and of solenoid parameters are presented as well as a short description of the solenoid and gradient coil construction. The results of the relative magnetic measurements of the solenoid and gradient coil fields are also given. (auth)

6509 (UCRL-Trans-1492) COHERENT BEHAVIOR IN THE TOMSK BETATRONS. Moskalev, B. A. Dec 1972. Translated by G. Brodell from a paper to be published in Proceedings of 3rd All Union Conference on Particle Accelerators, Moscow, October 2, 1972. (CONF-721029-7). 5p. Dep. NTIS $3.00.

From 3rd all-union national conference on particle accelerators; Moscow, USSR (2 Oct 1972).

A study to find the connection between the generation of high-frequency radiation and electron loss during acceleration in a 15-MeV betatron is described. The radiation, the intensity of the residual gas glow proportional to the beam current, and the electron loss resulting in scattered x radiation were measured simultaneously. It was found that the coherent buildup of the beam during the process of acceleration in high-powered betatrons can lead to particle loss; and the main part of the particles scatter in the vertical direction although the direction of scattering depends on the wave frequency in the betatron. (WHK)

6510 ELECTRON LENSES. Mulvey, T.; Wallington, M. J. (Aston Univ., Birmingham, Eng.). Rep. Progr. Phys.; 36: No. 4, 347-421(1973).

The optical properties and practical realization of ion and electron lenses are reviewed. Attention has chiefly been directed to electrostatic and magnetic electron lenses of rotational or planar symmetry, especially to those which seem to offer advantages in scientific instruments. Various competing methods of calculating the optical properties are analyzed in some detail, with particular emphasis on the mathematical assumptions involved and their relevance to the real lens structure. Thus in the computation of magnetic electron lenses, methods are discussed that enable the whole of the magnetic circuit and the energizing coil to be taken into consideration. For magnetic lenses, extensive data are provided concerning lens properties. The actual performance of contemporary magnetic lens designs, including flat helical lenses and superconducting lenses, is compared with the ultimate performance that is physically possible. A final section describes some of the important developments that have taken place in electrostatic lenses, both as separate imaging elements and as an integral part of ion sources and electron guns of extremely high brightness. The review concludes with an attempt to identify those computational methods that are most likely to be valuable in the future not only for the accurate computation of individual lenses but also for complete systems. (auth)

6511 MEASUREMENT OF THE FREQUENCY OF PARTICLE REVOLUTION IN AN ISOCHRONOUS CYCLOTRON. Novikov, D. L.; Onishchenko, L. M.; Shishlyannikov, P. T. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 988-990(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 21-23(1972).

A method for measuring the frequency of particle revolution in a cyclotron is described, and the results of the experimental determination in an electronic model of a ring cyclotron are presented. (auth)

6512 DEFORMABLE BEAM TRANSPORT SYSTEM WITH EXTRACTION PORT. Nixon, J. M.; Ramler, W. J. (to United States Atomic Energy Commission). U. S. Patent 3,723,785. 27 Mar 1973. Filed date 23 May 1972. 6p.

A beam transport device for a particle beam traversing first and second sections of a beam tube includes a pair of bellows each having an end mounted to an associated one of the sections of the beam tube is described. Interposed of the bellows and sealed to associated ends thereof are a particle-beam-extraction window and a rigid hollow member juxtaposed of the extraction window. Motive means are coupled to provide motion to the extraction window and rigid hollow member whereby they may be respectively aligned with the particle beam upon deformation of the bellows. (Official Gazette)

6513 INVESTIGATION OF LOW FREQUENCY INSTABILITIES IN A LINEAR PLASMA BETATRON. Lutsenko, E. I.; Kontsevoi, L. M.; Bondarenko, V. A.; Sereda, N. D. (Kharkov State Univ.). Zh. Eksp. Teor. Fiz.; 64: No. 3, 833-842(Mar 1973). (In Russian).

Low frequency instabilities ($\omega_{Hi} \ll \omega \ll \omega_{He}$) leading to restriction of the beam current in a linear plasma betatron are investigated. Conditions for appearance of oscillations and their dispersion properties (frequency characteristics and space structure) are studied. Development of the instabilities is accompanied by anomalous plasma diffusion and a shift of the plasma across the magnetic field. Consequently the instabilities are a serious obstacle for formation of intense electron beams in the plasma. The experimental results are compared with theories of current-convective beam instability in an inhomogeneous plasma and of excitation of helical waves by a beam. (auth)

6514 PROGRAM FOR CLOSED ORBIT MINIMIZATION BY ANALYTIC TECHNIQUE. Trotman, J. V. (Rutherford High Energy Lab., Chilton, Eng.). Comput. Phys. Commun.; 5: No. 1, 56-63(Jan 1973).

The computer program COMBAT, in FORTRAN 4 for an IBM 360/195 or 360/175 with a 40 K word storage requirement for minimizing closed orbit errors resulting from guide field imperfections in a synchrotron is described. The correlation between the distorted closed orbit and the correcting elements is expressed as a set of linear simultaneous equations and solved for minimizing the errors. (WHK)

Storage Rings

6515 (BNL-17820) VACUUM SYSTEMS FOR STORAGE RINGS. Halama, H. J. (Brookhaven National Lab., Upton, N. Y.). 9 Apr 1973. 14p. Dep. NTIS $3.00.

A discussion of vacuum systems for intersecting storage rings using both superconducting and conventional magnets is presented. It is shown that a circulating current I > 15 A can be achieved in a 7-cm-diameter vacuum chamber pumped every 3 m by 200 to 300 liter/sec pumps. A very economical and effective vacuum system can be built in narrow-gap, room-temperature magnets by utilizing distributed titanium sublimation pumping. Finally, pertinent experiments to study cryosorption, outgassing and desorption due to ion bombardment are outlined. (auth)

6516 (CERN/ECFA-72/4(Vol.2), pp 249-261) COLLIDING BEAMS. Jan 1973.

In ECFA: 300 GeV Working Group.

Colliding beam devices, mainly p-p, but also e-p devices, are discussed; and the DESY e-p colliding beam project is reviewed. (WHK)

6517 (LNF-73/6) BEAM-BEAM LIMITS. Amman, F. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).

Laboratori Nazionali di Frascati). 22 Feb 1973. 3p. (CONF-730310-49). Dep. NTIS (U.S. Sales Only) $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

Comments are presented on the limit set on the performances of storage rings by the forces due to beam–beam interactions. (WHK)

6518 (RHEL/R-252, pp 34-43) STORAGE RINGS. Egginton, A. J. (Daresbury Nuclear Physics Lab., Eng.). Apr 1972.

From meeting of the Daresbury–Rutherford accelerator working party; Abingdon, England (16 Dec 1971).

A brief review on electron–electron, electron–proton, and proton–proton storage rings is given. Storage rings in operation and under construction are listed. (WHK)

Experimental Facilities

Refer also to abstracts 5699, 5781, and 5963.

6519 (CERN/ECFA -72/4(Vol.1)) ECFA: 300 GeV WORKING GROUP. Volume I. Status Report of the Working Parties. (European Organization for Nuclear Research, Geneva (Switzerland)). Jul 1972. 450p. Dep. NTIS (U. S. Sales Only).

Separate abstracts were prepared for the nine sections presented. (WHK)

For abstracts of individual sections see: 5780, 5781, and 6520–6526.

6520 (CERN/ECFA–72/4(Vol.1), pp 3-66) USE OF BEBC AT SPS ENERGIES. Jul 1972.

In ECFA: 300 GeV Working Group.

The utilization of BEBC at the SPS, event recognition and kinematics, neutral detection in BEBC at the SPS, hadron fit-physics with BEBC at the SPS, possible hybridization schemes for BEBC, a two-arm spectrometer design to accommodate dispersion in a vertical magnetic field associated with a vertex detector, beams for BEBC, and particle identification for BEBC at SPS energies are discussed. (WHK)

6521 (CERN/ECFA–72/4(Vol.1), pp 67-116) TECHNICAL POSSIBILITIES OF GARGAMELLE. Jul 1972.

In ECFA: 300 GeV Working Group.

The question of the possible use of Gargamelle with the 300-GeV accelerator is discussed. The general problems concerning the use of Gargamelle, particularly the accuracy estimation, the separation of hydrogen events, and the identification of γ-rays and π°, are considered. The feasibility of particular experimental areas such as neutrino physics, diffraction dissociation reactions, and high multiplicity physics are considered. Also, the technical and financial implications of setting up Gargamelle in the West area of CERN II are outlined, and operating programs are envisioned. (WHK)

6522 (CERN/ECFA–72/4(Vol.1), pp 145-195) NEUTRINO FACILITIES. Jul 1972.

In ECFA: 300 GeV Working Group.

Studies for the possible neutrino physics facilities at the 300-GeV accelerator are summarized. Topics include possible layouts, beam questions, and detectors. (WHK)

6523 (CERN/ECFA–72/4(Vol.1), pp 197-246) CHARGED LEPTON AND PHOTON BEAMS. Jul 1972.

In ECFA: 300 GeV Working Group.

Topics include calculations of a μ-beam for CERN II, a high-intensity muon beam design for CERN II, possible μ-2 facility for the North Area, requirements for an e–γ beam, a tagged photon beam in the 100 GeV/c region, a tagged photon beam in the West Hall for the CERN SPS, coherent production of polarized bremsstrahlung and electron pairs in the 100 GeV region, a way of increasing the intensity of a high-energy electron beam at the SPS, radiative corrections to inelastic electron and muon scattering at high energies, electron–proton colliding beams, and the use of synchronous radiation for the detection of high-energy electrons. (WHK)

6524 (CERN/ECFA–72/4(Vol.1), pp 247-294) HADRONIC BEAMS. Jul 1972.

In ECFA: 300 GeV Working Group.

Topics include a proposed wide-momentum range charged hyperon beam for the CERN SPS; a charged hyperon beam for the SPS; a high-energy neutron beam; a long-lived neutral kaon beam; a short-lived neutral beam; high-energy, long spill, separated beams; high-energy polarized proton beam from Λ^0 decay, and a polarized neutron beam. (WHK)

6525 (CERN/ECFA–72/4(Vol.1), pp 295-349) SPECTROMETERS AND USE OF OMEGA. Jul 1972.

In ECFA: 300 GeV Working Group.

Topics include beams and physics, event identification in Omega up to 100 GeV/c, improvements on the Omega spectrometer, summary of possible options for the Omega spectrometer at the SPS, spectrometer and apparatus for experiments in a hyperon beam at the SPS, a focusing spectrometer for operation up to 200 GeV/c, a toroidal magnetic field spectrometer for experimentation with high-energy beams, a multiparticle forward spectrometer, and differential cross sections for some two-body and quasi-two-body reactions extrapolated to high energies. (WHK)

6526 (CERN/ECFA–72/4(Vol.1), pp 391-442) EXPERIMENTAL AREAS AND SHIELDINGS. Jul 1972.

In ECFA: 300 GeV Working Group.

Development of the 300-GeV accelerator North Experimental Area, general comments on the West Area layout, a target station, a comparison of the performance and cost of 400-GeV superconducting and conventional beam lines, and a proposal for a high-energy rf separated beam for BEBC at SPS energies are discussed. (WHK)

6527 (CERN/ECFA–72/4(Vol.2)) ECFA: 300 GeV WORKING GROUP. Volume II. Proceedings of the Second Tirrenia Study Week, Tirrenia, Italy, 20–29 September 1972. (European Organization for Nuclear Research, Geneva (Switzerland). Jan 1973. 263p. Dep. NTIS (U. S. Sales Only).

Separate abstracts were prepared for the seven sections presented. (WHK)

For abstracts of individual sections see: 6495, 6516, 6528–6530, 6720, and 6790.

6528 (CERN/ECFA–72/4(Vol.2), pp 29-84) EXPERIMENTAL AREAS. Jan 1973.

In ECFA: 300 GeV Working Group.

Topics include output beams from the SPS, possible utilization of the West Hall, layout of the 300-GeV North Experimental Area, comments on the hadronic beam session, and alternative use of the polarized proton beam layout for a charged particle beam. (WHK)

6529 (CERN/ECFA–72/4(Vol.2), pp 125-184) ELECTRON, MUON, AND PHOTON PHYSICS. Jan 1973.

In ECFA: 300 GeV Working Group.

Topics include possibilities in electron and photon beams around the world, electron versus muon physics, comments on e, μ, and photon sessions, background processes in high-energy photon tagging systems, and some comments on chicanes and electron beams. (WHK)

6530 (CERN/ECFA–72/4(Vol.2), pp 185-224) EXPERIMENTAL TECHNIQUES. Jan 1973.

In ECFA: 300 GeV Working Group.

Comments on BEBC hadron sessions, the Gargamelle session, the Omega and spectrometer sessions, on new facilities in visual devices, and on identification sessions are presented. Also, kinematical analysis at high energies, considerations on the design of a vertex detector for SPS energies, and a comparison of properties of rapid-cycling bubble chambers and streamer chambers are discussed. (WHK)

6531 (CERN/ECFA–72/4(Vol.3)) ECFA: 300 GeV WORKING GROUP. Volume III. Final Report of the Executive Committee. (European Organization for Nuclear Research, Geneva (Switzerland)). Feb 1973. 13p. Dep. NTIS (U. S. Sales Only).

The recommendations of the Executive Committee on the experimental facility needed for effective use of the SPS during the first two years of its operation are presented. Layouts of the beams in the West Area and in the North Area are given, and use of existing physics equipment such as BEBC and Gargamelle and the Omega spectrometer is recommended. Also, recommendations for new experimental equipment are included. (WHK)

6532 (LA–4586-MS(Rev.)) LAMPF USERS HANDBOOK (PRELIMINARY VERSION). Agnew, L. E. Jr. (Los Alamos Scientific Lab., N. Mex.). Mar 1973. Contract W-7405-eng-36. 56p. Dep. NTIS $5.00.

A general description of the facility and procedures for proposing experiments are given. (TFD)

6533 (LA–5144) DESIGN AND OPERATION OF A MICROPROGRAMMED BRANCH DRIVER FOR A PDP-11 COMPUTER. Biswell, L. R.; Rajala, R. E. (Los Alamos Scientific Lab., N. Mex.). May 1973. Contract W-7405-eng-36. 28p. Dep. NTIS $3.00.

A microprogrammed branch driver (MBD) is the interface between PDP-11 series computers and a multicrate CAMAC system. It is a microprocessor-controlled, multiple, direct-memory-access (DMA) channel branch driver. The MBD requirements stem from design of the Clinton P. Anderson Meson Physics Facility data-acquisition system. The desire for a standard system, the types of experiments and data rates, and the varying complexity of the data-acquisition systems directed a microprogrammable, multiple DMA channel branch driver. A brief description of CAMAC aids in understanding MBD operation and design. Trade-offs between cost and capabilities, and decisions that led to the final design are discussed. Computer and CAMAC interface requirements dictated much of the design; the rest was determined by the desirability of a microprocessor with a read-write control memory. To facilitate checkout, and to serve as a manual controller when the MBD was used as a stand-alone branch driver, a PDP-11 simulator was built. A control-panel option simplified loading of the bootstrap loader for a stand-alone system. After the bootstrap was loaded, the control programs could be loaded from a teletype, paper-tape reader, or data link. Basic MBD operation and capabilities are discussed. Programs to load the MBD memory from the PDP-11, to initialize the channels, and to control programs are given, and performance specifications are summarized. (auth)

6534 INSTALLATION FOR RECORDING THE DECAYS OF K^0 MESONS. Avakyan, K. M.; Asatiani, T. L.; Zhirova, L. A.; Ivanov, V. A.; Krishchyan, V. M.; Mnatsakanyan, E. A. (Inst. of Physics, Erevan). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 1036-1038(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 61-63(1972).

An installation is described which is designed to measure the photoproduction cross section and investigate the momentum spectrum of K^0 mesons. Wide-gap spark chambers are used in the installation. The momentum spectrum of K^0 mesons obtained for a maximum γ-beam energy $E_\gamma^{max} = 0.4$ GeV on an aluminium target at an angle 10° with respect to the direction of the γ beam is presented. The error in measuring the momenta of K^0 mesons in the range from 1 to 4.5 GeV/c is 1 to 1.5%. (auth)

6535 OPERATION OF THE EG-2.5 ELECTROSTATIC ACCELERATOR IN A PULSED MODE. Strizhak, V. I.; Bobyr, V. V.; Totskii, Yu. I.; Tustanovskii, V. T.; Yarotskii, V. I. (Kiev State Univ.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 1000-1001(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 32-33(1972).

A circuit has been developed for obtaining a pulsed beam of neutrons having energies of 14 to 19 MeV using the EG-2.5 electrostatic generator for the purpose of investigating (n,p) and (n,α) reactions involving ^{6}Li, ^{9}Be, ^{11}B, and ^{12}C. (auth)

6536 USE OF DEFLECTION BUNCHING TO OBTAIN INTENSE SHORT NEUTRON PULSES IN THE CYCLOTRON OF THE ATOMIC ENERGY INSTITUTE. Breslavtsev, I. D.; Venikov, N. I.; Dvornikov, V. D.; Kuleshov, I. L.; Latushkin, S. T.; Rezvov, V. A.; Chumakov, N. I.; Yudin, L. I. (Inst. of Atomic Energy, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 994-999(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 26-31(1972).

Intense short neutron pulses having a broad energy spectrum (a "white" neutron beam) were formed in the cyclotron of the Atomic Energy Institute by means of deflection bunching. For this purpose systems were developed for high-voltage nanosecond power supply, synchronization, control, and diagnosis of the ion beam, which allowed intense neutron pulses having a frequency of up to 110 kHz to be obtained. After the cyclotron has been transferred to an isochronous operating mode, the system allows operation with fast neutrons according to the time-of-flight method in the energy range from 0.5 to 30 MeV with a flux density of $\sim 5 \cdot 10^4$ sec^{-1} $\cdot$ cm^{-2} at the end of the 80-meter transit path and with a resolving power of 200 eV at an energy of 0.5 MeV. (auth)

6537 LOW-TEMPERATURE TARGETS FOR PHYSICAL RESEARCH WITH HIGH-ENERGY ELECTRONS AND PHOTONS. Gol'dshtein, V. A.; Lubyani, V. V.; Germanov, A. I. (Physical Technical Inst., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 1007-1010(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 37-40(1972).

The construction and principal characteristics of two low-temperature targets which allow measurement of the background and operation with one or two fillers (for example, H or H,D) are presented. The changing of the appendix for the accelerator beam is achieved by raising the target in the first case, while in the second it is achieved by rotating the target through 120°. (auth)

6538 THREE-METER LIQUID-HYDROGEN–DEUTERIUM TARGET HAVING A STABILIZED DENSITY. Vasil'ev, L. M.; Dmitrevskii, Yu. P.; Mel'nik, Yu. M.; Sytnik, V. V. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 1004-1005(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 35-36(1972).

A three-meter liquid-hydrogen–deuterium target having a stabilized density is described, which is used in experiments on particle beams in the accelerator at the Institute of High-Energy Physics. The thermal shielding of the working liquid is achieved by means of the exhaust vapors. The average quantity of parahydrogen along the target axis is 21.15 g/cm^2. The stability of the hydrogen density in the working section is ~0.05%. The total capacity of the target is 205 liters. The operating-time without refilling is 200 h. (auth)

6539 DEVICE FOR MEASUREMENT OF THE LENGTH OF LIQUID HYDROGEN TARGETS. Dmitrevskii, Yu. P.; Elistratov, V. V.; Prudkoglyad, A. F. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1256-1257(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 238-239(1972).

An optical device is described that allows measurement of the length of a liquid-hydrogen target and the bending deflection of their beam windows in the cold state through transparent windows of the vacuum housing at distances of from 110 to 850 mm with an accuracy of 0.1 mm. (auth)

6540 MODEL OF A LARGE 270-DEGREE MAGNETIC ANALYZER WITH DOUBLE FOCUSING. Basargin, Yu. G.; Boldin, N. I.; Gofman, Yu. V.; Korolev, L. E.; Levchenko, V. G.; Maidikov, V. Z.; Severgin, Yu. P. pp 210-215 of Prikladnaya Yadernaya Spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

6541 LIST OR SORT. Some Experience with the ORIC Multiparameter Data Acquisition System. Hensley, D. C. (Oak Ridge National Lab., TN). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 334-341(Feb 1973).

The data acquisition system at the ORIC is reviewed, and several of the data acquisition techniques used are described. The experience of two years of data acquisition with the system is discussed, and a special effort is made to assess the merits and capabilities of an associative memory technique. A current development in the programs for data acquisition is sketched, and a simple graphics technique for line printers is presented which permits plotting 3 data points per line. (auth)

6542 DESIGN OF A DATA ACQUISITION SYSTEM FOR LASS. Armstrong, G.; Friday, R. G.; Hutchinson, D.; Mauro, K.; Shapiro, S.; Williams, S. H. (Stanford Univ., CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 342-347 (Feb 1973).

The large aperture solenoid spectrometer (LASS) now under construction at SLAC will put a strain on already existing data acquisition equipment to handle the projected 100 kiloword per second data rate. In order to meet this higher data rate and also provide a flexible data system to handle multiple users a new data acquisition system is being designed and is described. (WHK)

6543 HIGH YIELD NEUTRON TARGET FOR CANCER THERAPY. Alger, D. L.; Steinberg, R. (Lewis Research Center, Cleveland). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 420-425(Feb 1973).

A rotating target has been developed that has the potential for providing an initial yield of 10^{13} neutrons per second by the T(d,n)He^4 reaction, and a useable lifetime in excess of 600 hours. This yield and lifetime are indicated for a 300 KV and 30 mA deuteron accelerator and a 30 μm thick titanium tritide film formed of the stoichiometric compound TiT_2. The potential for extended lifetime is made possible by incorporating a sputtering electrode that permits use of titanium tritide thicknesses much greater than the deuteron range. The electrode is used to remove in situ depleted titanium layers to expose fresh tritide beneath. The utilization of the rotating target as a source of fast neutrons for cancer therapy is discussed. (auth)

6544 LONG DISTANCE CAMAC BRANCH VIA DATA-LINK AND MICROPROGRAMMED BRANCH DRIVER. Biswell, L. R.; Machen, D. R.; Potter, J. M.; Rajala, R. E.; Thomas, R. F. (Los Alamos Scientific Lab., NM). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-21: No. 1, 675-679(Feb 1973).

An unusual solution to the problem of remote operation of CAMAC data systems has been implemented at the Clinton P. Anderson Meson Physics Facility (LAMPF). Data-link communications from a remote CAMAC system, controlled only by a Microprogrammed Branch Driver (MBD), to another CAMAC system coupled to a digital computer, can effectively extend the CAMAC branch highway to several hundred meters. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 5787 and 7013.

6545 (N–72–32786) PHOTOIONIZATION MEASUREMENT STUDY. Final Report, 26 February 1971–25 February 1972. Sandri, G. (Aeronautical Research Associates of Princeton, Inc., N. J.). Feb 1972. Contract NAS5-11402. 41p. (NASA-CR–130064). NTIS.

An analysis was conducted of a gas window photoionization device for studying cosmic x rays in the region 20 eV to 1 keV. The detecting element is an argon proportional counter whose window is a two-dimensional supersonic gas jet. Spectroscopic features of the incoming radiation can be determined by the choice of gas forming the jet (as well by the fluid dynamic parameters of the flow). The choice of gas can be made from pure substances and/or compounds with Z between 1 and 10. The counter walls can be prepared for selective analysis of the extreme ultraviolet radiation. (auth) (STAR)

6546 GAMMA ASTRONOMY AND COSMIC RAYS. I. Ginzburg, V. L. (Lebedev Inst. of Physics, Moscow). Comments Astrophys. Space Phys.; 4: No. 6, 167-172(1972).

Information on the origin of primary cosmic radiation obtainable from a study of cosmic gamma radiation is considered. (WDM)

6547 GAMMA ASTRONOMY AND COSMIC RAYS. II. Ginzburg, V. L. (Lebedev Inst. of Physics, Moscow). Comments Astrophys. Space Phys.; 5: No. 1, 15-21(1973).

Two examples are considered of concrete astronomical objects, the Magellanic clouds and the central region of the Milky Way, a study of which should decide the fate of the metagalactic models of cosmic-ray origin. (WDM)

6548 RADIO-PULSES IN EAS. Barua, P.; Ghose, A.; Pathek, K. M. (Gauhati Univ., India). J. Assam Sci. Soc.; 13: 77-81(Dec 1970).

The emission of radio pulses in extensive air showers is calculated on a simple model of geomagnetic separation of positive and negative charges in showers. The dependence of shower disc thickness on the frequency of the radiated spectrum is also investigated. It is found that the frequency spectrum along the shower axis is independent of frequency of radio emission. But the frequency spectrum at points off the shower is a falling function of frequency. It may be mentioned that from the experimental point of view, the possibility of studying large air showers (whose frequency of production is very small) by radio-pulse detection method has opened up an altogether new line of approach in the study of high-energy nuclear physics of energies above 10^{16} eV or so. (INIS)

6549 EXCITATION ATMOSPHERIC GASES BY LOW ENERGY PROTON BOMBARDMENT. Ghosh, S. N. (Allahabad Univ., India). Indian J. Radio Space Phys.; 1: No. 1, 25-30(1972).

Various features of excitation of spectra of atmospheric gases by low energy (560 eV to 1.7 keV) proton bombardment are described. The target gases were N_2, air, and (air, O_2) mixtures. Spectroscopic, photometric, and microphotometric studies were made. The mechanisms for the several excited spectra are discussed in the light of known data of collisional processes. 38 references (ISA)

6550 SPECTRUM OF THE COSMIC X- AND GAMMA-RAY BACKGROUND IN THE ENERGY RANGE 1 keV to 1 MeV. Kasturirangan, K.; Rao, U. R. (Physical Research Lab., Ahmedabad, India). Astrophys. Space Sci.; 15: No. 1, 161-166(Jan 1972).

Available satellite, rocket, and balloon observations on cosmic x- and gamma-ray background are critically examined to understand the spectral characteristics of the radiation. Appropriate corrections have been applied to the balloon observations to account for the multiple Compton scattering of x rays in the atmosphere. It is shown that within the experimental uncertainties, all the available observations of cosmic x- and gamma-ray background in the energy range 1 keV to 1 MeV are consistent with a single spectrum of type $dN/dE = 30E^{-2.0\pm0.2}$ photons cm^{-2} s^{-1} sr^{-1} keV^{-1}. (auth)

6551 STUDIES OF THE CHEMICAL COMPOSITION OF COSMIC RAYS WITH Z = 3 to 30 AT HIGH AND LOW ENERGIES. Webber, W. R.; Damle, S. V.; Kish, J. (Univ. of New Hampshire, Durham). Astrophys. Space Sci.; 15: No. 2, 245-271(Feb 1972).

The chemical composition of cosmic rays with $Z \geq 2$ was measured over an energy range from ~100 MeV/N to >2 GeV/N using 2 new large area counter telescopes. One of these instruments was a 4 element dE/dx × E × Range telescope, the other a 4 element dE/dx × Cherenkov × Range telescope. Two balloon flights with these telescopes at Ft. Churchill in the summer of 1970 provided a total of nearly 1000 Fe nuclei with a charge resolution ranging from ~0.10 charge unit at carbon to ~0.25 charge unit at Fe. A detailed charge spectrum was obtained at both high and low energies. Some important differences exist between the present results and those obtained earlier, due in part to the improved statistical accuracy and in part to the improved background rejection of the present data. In particular, the abundance of Cr and Mn were each found to be ~0.10 × Fe in contrast to the earlier ratio of ~0.30 found by some workers for each of these nuclei. The abundance of these two nuclei, as well as others in the 15 to 25 range, showed no strong dependence on energy. The composition data were extrapolated to the cosmic-ray sources using a variety of interstellar path length distributions. The abundances of all secondary nuclei with Z between 3 to 25 were consistent only with propagation models which have vacuum path length distributions which do not differ greatly from exponential. The source abundances of nuclei with Z = 15, 17, 18, 19, 21, 22, 23, 24, and 25 were found to be <0.02 × Fe. For the remaining nuclei, Na, Al, S, and Ca were found to have source abundances of 0.07, 0.11, 0.18, and 0.13 of Fe respectively. The source abundance of C and O relative to Fe was also much different than some earlier compilations. A comparison of solar and cosmic-ray abundances revealed certain selective differences, rather than a systematic overabundance of heavy nuclei in cosmic rays, as has been suggested in the past. These differences are discussed in terms of a common nucleosynthesis origin of the two species of particles. (auth)

6552 SPECTRUM OF DIFFUSE COSMIC X RAYS IN THE 20 TO 125 keV RANGE. Manchanda, R. K.; Biswas, S.; Agrawal, P. C.; Gokhale, G. S.; Iyengar, V. S.; Kunte, P. K.; Sreekantan, G. V. (Tata Inst. of Fundamental Research, Bombay). Astrophys. Space Sci.; 15: No. 2, 272-283(Feb 1972).

Diffuse cosmic x rays in the energy range 20 to 125 keV were measured in four balloon flights from Hyderabad, India during 1968–70 using almost identical x-ray telescopes mounted on oriented platforms. The results from these flights show that the spectrum of the diffuse cosmic x rays can be represented by the form $dN/dE = 29\ E^{-2.1\pm0.3}$ photons/(cm^2 sr s keV) in 20 to 125 keV interval after corrections for photoelectric absorption and Compton scattering effects in the atmosphere. The best fit spectrum of all published results in the energy interval 20 to 200 keV can be represented by the form $dN/dE = 36\ E^{-2.1\pm0.1}$ photons/(cm^2 sr s keV) after similar corrections are effected, and there is no need for a change of spectral index in this energy interval. The intensity at 20 keV obtained from the above spectrum agrees well with that given by the spectral form $dN/dE = 10\ E^{-1.7\pm0.1}$ photons/(cm^2 sr s keV) in the energy interval 1 to 20 keV in several rocket experiments. Therefore it is concluded that if there is a break in the spectrum, it occurs between 10 and 20 keV with a change of spectral index by about 0.5, or the index is continuously changing from 1.7 ± 0.1 to 2.1 ± 0.1 in 10 to 20 keV interval. The implications of the results are briefly discussed. (auth)

6553 NEUTRINO SPECTRUM AND THE SOLAR-NEUTRINO EXPERIMENT. Pakvasa, S.; Tennakone, K. (Univ. of Hawaii, Honolulu). Lett. Nuovo Cim.; 6: No. 16, 675-676(21 Apr 1973).

An attempt is made to find an explanation for the unexpectedly low counting rate of solar neutrinos in the experiment of Davis (Bull. Am. Phys. Soc., 16: 631(1971)) from a recently proposed model of leptons that predicts a series of neutrinos of different masses. (LBS)

6554 DUST GRAIN ORIGIN OF COSMIC-RAY AIR SHOWERS. Hayakawa, S. (Nagoya Univ., Japan). Astrophys. Space Sci.; 16: No. 2, 238-240(May 1972).

It is suggested that cosmic rays of energies as high as 10^{20} eV consist of dust grains of relativistic energies. Such dust grains as typical in interstellar space are accelerated first by a strong radiation pressure of luminous, compact galaxies and then by magnetic processes. A grain with the mass of about 10^{-16} g and the Lorentz factor of about 10^3 attains an energy as large as 10^{20} eV and produces a huge extensive air shower. Such grains survive against the collisions with cosmic microwave photons. This would remove the serious difficulty, if both the cosmic microwave radiation and the huge extensive air showers, which were regarded as due to protons of energies greater than 10^{19} eV, existed in spite of that the protons should strongly attenuate by the collisions with the radiation. (auth)

Stars

Refer also to abstracts 6623, 6764, and 7080.

6555 (N-73-10824) PECULIAR O6f STAR HD 148937 AND THE SYMMETRICALLY SURROUNDING NEBULAE. Johnson, H. M. (Lockheed Missiles and Space Co., Palo Alto, Calif.). 1972. Contract NASW-1977. 13p. (NASA-CR-128404). NTIS.

The ultraviolet continuum of the star is observed and, after standard reddening corrections are applied, it is found to be hotter than a model 05 V star. The Of star and its two companions are photometered around wavelength 4640, 4686, and 4861 A. The results confirm Westerlund's (1960) absolute visual magnitude of about −6 for the Of star and confirm his rejection of NGC 6164-5 as a planetary nebula. Peculiarities of the system of nebular shells around HD 148937, of which NGC 6164-5 are the innermost, are discussed with reference to radiofrequency data. A standard extrapolation from the optical flux density of NGC 6164-5 predicts a detectable radio source but it does not appear in the relevant surveys. (auth)

6556 (NP-19728) APPARENT CONNECTION BETWEEN SPACE VELOCITY AND ROTATIONAL VELOCITY IN EARLY TYPE STARS. Havnes, O. (Oslo Univ. (Norway). Institutt for Teoretisk Astrofysikk). 1971. 32p. Dep. NTIS (U.S. Sales Only) $3.75.

An apparent increase in space velocity with increasing rotational velocity for single stars earlier than B4 was reported in Havnes (1968). A larger sample of stars is considered and the same tendency is found for field stars earlier than B6, while the stars from B6 to B9 do not show the same tendency. Some increase of average space velocity with increasing rotational velocity is also found in double stars, cluster members etc. The possibility is considered that systematic errors in the determination of spectral class (absolute magnitude) may be present due to the rotation of the star. If systematic errors in magnitudes of the order of $M_v = (v_r \sin i/400)^2$ are present ($v_r \sin i$ in km/s) most of the increase in space velocity with rotational velocity for the double stars, cluster members etc. may be explained. For the field stars earlier than B6 such a "systematic error" can only remove a minor part of the corresponding increase in space velocity. However, regressional analysis of the distribution of rotational velocity versus space velocity for the different groups of stars show the correlations to be low. (auth)

6557 (UCRL-74669(Rev. 1)) INFLUENCE OF SCREENING EFFECTS ON CARBON IGNITION. Graboske, H. C. Jr. (California Univ., Livermore. Lawrence Livermore Lab.). 29 Mar 1973. 14p. (CONF-730415-2). Dep. NTIS $3.00.

From conference on explosive nucleosynthesis; Austin, Texas, USA (2 Apr 1973).

A generalized screening theory has produced a revised strong screening factor which significantly reduces the densities at which carbon ignition can occur in helium-exhausted carbon−oxygen stellar core models. The form of the strong screening factor causes a reversal in the temperature dependence of the carbon energy generation rate at $\tau/\Gamma_8 = 7$, which leads to a double-valued set of carbon ignition lines. Current nuclear energy rates and neutrino emission processes indicate carbon ignition must occur centrally and at densities of the order of 2 to 3×10^9 gm/cm^3. A possible mechanism is suggested for nonviolent carbon ignition in a highly degenerate fuel. At or near the intersection of the screening transition and carbon ignition lines, a minimum energy rate with very weak temperature dependence will exist and ignition at this location may allow at least initially nondisruptive, quasistatic carbon burning. (auth)

6558 HIGH RESOLUTION OBSERVATIONS OF NGC 7027 AT 5 GHz. Scott, P. F. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 4, 35P-38P(1973).

The planetary nebula NGC 7027 has been observed at a frequency of 5.0 GHz with 2.0 arc sec resolution. The observed brightness distribution is consistent with emission from a thick cylindrical shell with its axis at 30° to the line-of-sight and having a uniform electron temperature and density of $(13 \pm 2) \times 10^3$ K and $(5.0 \pm 0.5) \times 10^4$ cm^{-3}, respectively. The earlier interferometric measurement by Miley (Astrophys. Lett.; 6: 17 (1970)) can be explained by this model without invoking a nonthermal component. (auth)

6559 MODEL ATMOSPHERE ANALYSIS OF THE SUPER-SUPERGIANT HR 5171. Warren, P. R. (Radcliffe Observatory, Pretoria). Mon. Notic. Roy. Astron. Soc.; 161: No. 4, 427-444(1973).

A model atmosphere analysis based on five high dispersion spectra of the super-supergiant HR 5171 is presented. The abundances are essentially solar except for sodium which may be overabundant. Shell effects have been considered and, although no evidence of a low-temperature shell has been found from the spectra, the existence of a high-temperature, low-density envelope is indicated by the presence of weak nebular [N II] emission. (auth)

6560 THIS IS WHERE STARS ARE FORMED. Wenzen, W. (Sonnenberg Observatory, Ger.). Jena Rev.; No. 7, 319-321(1972).

A short discussion is given on the T Tauri stars in the North American, Pelican, and Orion Nebulae. The special case of V 1057 cygni is mentioned. (WDM)

6561 ACCRETION OF MATTER BY CONDENSED OBJECTS. Michel, F. C. (Rice Univ., Houston, TX). Astrophys. Space Sci.; 15: No. 1, 153-160(Jan 1972).

The equations of motion for steady-state spherical symmetric flow of matter into or out of a condensed object (e.g. neutron stars, "black holes", etc.) are displayed and solved for simple polytropic gases. It appears that infalling matter may be heated as hot as 10^{12} K and that x-ray luminosities of the order of 10^{37} erg s^{-1} could result. The two fluid (electrons and ions separately) approach is also examined and it is shown that electrostatic fields of the order of 10^5 V m^{-1} are required near the surface of the object. Such fields are not strong enough to significantly modify the space−time metric. (auth)

6562 UBVRI COLOURS OF STRONG-LINE G DWARFS AND SUBGIANTS. Branch, D.; Alexander, J. B. (Royal Greenwich Observatory, Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 4, 409-420(1973).

The broad-band colours of 31 Aql (G8 IV), δ Pav (G8 V), and α Men (G5 V) differ markedly from the colours of Hyades dwarfs of similar temperatures. The known metallicity excesses of 31 Aql and δ Pav, relative to Hyades stars, do not appear to be large enough to cause the observed colour differences through blanketing by weak and medium-strength atomic lines. Blanketing by bands of C_2, CH, and CN, allowing for suspected overabundances of carbon relative to iron, is shown to be insufficient also. Synthetic-spectrum calculations by Bell (Mon. Not. R. Astron. Soc.; 154:343 (1971)) have shown that the colours of a strong-line G dwarf are very sensitive to the value of the damping constant. Present evidence on strong lines in the spectrum of δ Pav indicates that the damping constant in the atmosphere of δ Pav is higher than the expected value. (auth)

6563 SOME MEASUREMENTS OF Be STAR ENVELOPES. Kitchin, C. R. (Hatfield Polytechnic Observatory, Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 4, 389-392(1973).

Measurements on 48 lines from the envelope of 11 Be stars have been made. The envelope model and the radius of the emitting/absorbing region have been determined by the method outlined in earlier papers (Kitchin, Mon. Not. R. Astron. Soc.; 150:455 (1970), and 161:388 (1973)). The results may indicate that a change in the nature of Be star envelopes occurs at a distance of about 30 stellar radii. (auth)

6564 ENVELOPES OF Be STARS. Kitchin, C. R. (Hatfield Polytechnic Observatory, Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 4, 381-388(1973).

The method for determining the envelope radii of Be stars presented in an earlier paper (Kitchin, Mon. Not. R. Astron. Soc.; 150:455 (1970)) has been extended. It now gives comparatively unambiguous models for the envelopes and provides some measure of the size of the region of the envelope which is emitting or absorbing a line. (auth)

6565 ADIABATIC STABILITY OF STARS CONTAINING MAGNETIC FIELDS. 1. Toroidal Fields. Taylor, R. J. (Univ. of Sussex, Brighton, Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 4, 365-380(1973).

Conditions for the stability against adiabatic perturbations of a star containing a purely toroidal magnetic field are established. These conditions are necessary and sufficient for stability, if the change in gravitational field produced by the perturbation is neglected. They remain necessary for stability if the change in gravitational field is included. The criteria are given in closed algebraic form so that they can be applied readily, if an equilibrium model of a star with a toroidal magnetic field is proposed. Because the criteria are complicated, it is difficult to draw general conclusions from them. It is however possible to show that instability must occur close to the axis of symmetry of the star, if there is a nonzero electric current density on the axis. This proves that a large class of configurations are unstable. The occurrence of this instability depends only on the shape of the field and not on its strength, whereas in general the field strength will be important in determining instability. It is not easy to predict the ultimate effect of such instabilities. They have very short growth times compared to characteristic times of stellar evolution and, even if the instability is initially contained as an oscillation of finite amplitude, it may lead to a considerably enhanced decay of the magnetic field. It is unlikely that stars exist with a purely toroidal field, although it may be stronger than the poloidal component. However, models have previously been obtained of stars with only a toroidal field and their oscillation properties have been discussed. Because these discussions by other authors have involved integrals over the whole star, the localized instabilities found in this paper have not been discovered. (auth)

6566 PERIOD CHANGES IN β CEPHEI STARS. Comparison of Observation with Theory. Eggleton, P. P.; Percy, J. R. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 4, 421-425(1973).

The rate of period change due to evolution has been calculated for a β Cephei star of 16 $M_\odot$ by means of a theoretical evolutionary track. The dependence of this rate on mass has been estimated. This rate has been compared with observed rates of period change in a few β Cephei stars. Unfortunately, the uncertainty in the masses of the β Cephei stars and the possibility of nonevolutionary period changes make it impossible to determine precisely the evolutionary state of these stars. Nevertheless, it is unlikely that they are in the late gravitational contraction or early shell hydrogen burning phases of evolution. (auth)

6567 SURFACE COMPOSITION OF MAGNETIC NEUTRON STARS. Rosen, L. C. (Dartmouth Coll., Hanover, NH); Cameron, A. G. W. Astrophys. Space Sci.; 15: No. 1, 137-152(Jan 1972).

The relative abundances of seven constituent nuclei, ^{4}He, ^{12}C, ^{16}O, ^{20}Ne, ^{24}Mg, ^{28}Si, and ^{56}Fe, are calculated as a function of time for neutron star atmospheres within which exist magnetic fields of the order of 10^{13} G. The opacity, equation of state of the electrons, and cooling rate of the magnetic star are discussed, and it is shown to be a reasonable approximation to assume an atmosphere to be isothermal. The effects of particle diffusion are included in the nuclear reaction network. Computations are performed both for a constant mass atmosphere and for an atmosphere in which mass is being ejected. It is found that the final abundances are model independent as long as the initial model contains predominantly ^{4}He. The relative abundances are compared to the cosmic-ray spectrum. For both the constant mass and mass loss atmospheres, nucleosynthesis proceeds virtually completely to ^{56}Fe. However the outermost layers of the envelope, in which no mass is being ejected, are composed almost entirely of ^{4}He with trace amounts of ^{56}Fe. After the loss of about 10^{21} g, only ^{56}Fe is ejected from atmospheres expelling mass. (auth)

6568 STAR FORMATION BY CONDENSATION. I. Horedt, G. P. (Observatorul Astronomic, Cluj). Astrophys. Space Sci.; 15: No. 1, 129-136(Jan 1972).

Two possibilities for the formation of a star by transition of molecular hydrogen from gaseous to the liquid phase in the gravitational field of a spherical mass are described. Model A: Contraction through condensation of a polytropic respectively isothermal gas sphere. Model B: Condensation in the isothermal atmosphere which surrounds a core. Model B is sooner possible, because model A introduces certain restrictions of mass and radius of the protostar. (auth)

6569 NUMERICAL HYDRODYNAMIC STUDY OF COALESCENCE IN HEAD-ON COLLISIONS OF IDENTICAL STARS. Seidl, F. G. P. (Programming Methods, Inc., New York); Cameron, A. G. W. Astrophys. Space Sci.; 15: No. 1, 44-128(Jan 1972).

A two-dimensional hydrodynamic code was developed for numerical studies of stellar collisions. The motivation for the study was the suggestion by Colgate that collisions among stars in a dense galactic core can lead to growth of stellar masses by coalescence and thus to an enhanced rate of supernova activity. The specific results reported refer to head-on collisions between identical polytropes of index 3 having solar mass and radius. If the polytropes were initially at rest at infinity, then about 5 percent of the combined mass is lost by ejection following collision. The volatilized mass fraction rises to about 18% for an initial relative collision velocity of 1000 km s^{-1} at infinite separation, and to about 60% for the 2000 km s^{-1} case. Since the initial kinetic and gravitational energies balance for a relative velocity of 1512 km s^{-1} at infinity, it may be seen that net coalescence persists to velocities somewhat in excess of this figure. Mass ejection takes place in two ways simultaneously: (1) by a rapid sideward expulsion of fluid in a massive lateral sheet normal to the collision axis, and (2) as a result of two recoil shocks which lead momentum flows backwards along this axis. The lateral effect has similarities to the expansion of gas into a vacuum; that is, shocks are not involved. However, the ejection of material from the rear colliding hemisphere due to the recoil shocks predominates at low collision velocities. As the velocity increases, both effects strengthen, but the lateral expulsion intensifies more rapidly than the recoil shocks. (auth)

6570 SPECTRA OF SOME Be STARS BETWEEN 7000 AND 9600 A. Andrillat, Y. (Faculte des Sciences, Montpellier, France); Houziaux, L. Astrophys. Space Sci.; 15: No. 2, 240-244(Feb 1972). (In French).

Kodak IM plates were used in order to extend to 9600 Å the observed wavelength range for 23 O, B, Be, Bp, and A stars. The spectra are shown in the plate. Several atmospheric absorption bands perturb the continuum and line spectrum. Between 1.45 and 1.20 μ^{-1}, the parameter $d \log I_\lambda/d(1/\lambda)$ was measured. The results appear in the table and indicate that Be stars do not exhibit anomalous reddening in this spectral region. On the other hand the above parameter is much more sensitive to the reddening than to the star's effective temperature. (auth)

6571 FURTHER OBSERVATIONS OF THE RADIO STAR MWC 349. Gregory, P. C.; Seaquist, E. R. (Univ. of Toronto). Nature (London) Phys. Sci.; 242: No. 120, 101-102(16 Apr 1973).

Observations of the binary system MWC 349 at 10.52 and 6.63 GHz, during December 1972 and February 1973 using the 46m. telescope at the Algonquin Radio Observatory, are reported. No evidence was found for a change in flux density greater than 0.02 fu over this period, but the flux density values at 10.5 GHz were 30% lower than for earlier observations. Combining the measurements with earlier measurements at 1.4 and 5 GHz resulted in a spectrum consistent with a thermal radiation mechanism. Details are given of the experimental technique adopted. The measurements were interpreted as being representative of the radio emissions from the 2.4 arc s. component of MWC 349, but do not exclude the possibility that MWC 349 might exhibit occasional flare-like behaviour from a more compact component. The photographic magnitude of MWC 349 appears to have increased from 13.2 in 1933 to 15.5 in 1972, corresponding to a decrease in optical flux density of $\simeq$2% per month, but the accuracy of the measurements was not sufficient to decide on whether a similar gradual decrease in radio emission is occurring. A large infrared excess was found. The picture emerging for MWC 349 is that of a dense H II region surrounding a star of spectral class BO or earlier, together with a compact cloud of dust possibly surrounding a cool star, and an interesting possibility is that the dust cloud might be embedded in the H II region. (UK)

6572 CURRENT PROBLEMS ON ASYMPTOTIC BRANCH STARS. Castellani, V. (Univ., Rome); D'Antona, F. A. Astrophys. Space Sci.; 15: No. 2, 340-347(Feb 1972).

An effort is made to select, from the available observational data, information concerning the asymptotic branch stars. Particular care is devoted to derive luminosity functions for these stars in clusters representative of selected classes. Some theoretical predictions are briefly made. It is stressed that, from a theoretical point of view, the comparison between the one-shell H-burning evolutionary characteristics and the corresponding ones for the A. B. phase could be expected to provide a powerful means of investigation. (auth)

6573 STAR FORMATION IN THE GALAXY. Pendred, B. W.; Williams, I. P. Astrophys. Space Sci.; 15: No. 2, 334-339(Feb 1972).

A previous theory of the authors regarding the planetary system is generalized in an attempt to include star formation. It is found that the theory predicts the correct mass and radius for stellar clusters and also the general shape of the Galaxy. (auth)

6574 CONTINUOUS SPECTRA IN THE NEAR INFRARED OF TWO Be STARS: HD 50138 AND HD 51585. Andrillat, Y. (Faculte des Sciences, Montpellier, France); Houziaux, L. Astrophys. Space Sci.; 15: No. 2, 236-239(Feb 1972). (In French).

Continuous spectra of the Be objects HD 50138 and HD 51585 were investigated between 1.6 and 1.2 μ^{-1}. The infrared gradient ϕ_{IR} of HD 50138(B5eV) was found to be 2.09 ± 0.10, while the typical B5V star π and indicated $\phi_{IR} = 1.17$. A B5V (HD 16219) star located at about the same distance as HD 50138 had $\phi_{IR} = 1.29$ and it is shown that interstellar reddening may account for $\Delta\phi_{IR}$ between HD 16219 and π And. The difference in gradient between HD 50138 and HD 16219 ($\Delta\phi_{IR} = 0.8$) may be explained by a continuous reemission in a lenticular envelope with a radius equal to $4R_*$. The peculiar object HD 51585 exhibited a B0.5 continuous spectrum, for which the value $d \log I_\lambda/d(1/\lambda)$ should be 1.13 according to model atmospheres computations. The distance as derived from color excess led to disagreement between measured and computed (for a B0.5 star) values of $d \log I_\lambda/d(1/\lambda)$. The reddening may be explained by reemission in an envelope the radius of which is smaller than $5R_*$. In conclusion, the narrowness of the spectral range under consideration did not permit to decide whether the observed reddening was due to recombination to the third level of the hydrogen atom or whether it was part a thermal reemission in a circumstellar cloud at lower temperature, as has been observed around 10 μ by various authors. (auth)

6575 ORBITAL ECCENTRICITY OF AN ECLIPSING BINARY SYSTEM. Todoran, I. (Astronomical Observatory, Cluj). Astrophys. Space Sci.; 15: No. 2, 229-235(Feb 1972).

A new method is presented to precisely deduce the orbital eccentricity of an eclipsing binary from observed epochs of its light minima. Application to the system V526 Sagittarii gives e = 0.2220 ± 0.0016. (auth)

6576 Os–Pt–Hg ABUNDANCE PEAK IN Ap STARS AND THE PROBLEM OF VERY HEAVY COSMIC RAYS. Guthrie, B. N. G. (Royal Observatory, Edinburgh). Astrophys. Space Sci.; 15: No. 2, 214-228(Feb 1972).

Relative abundances in the region $74 \leq Z \leq 83$ (W to Bi) were determined for 73 Dra, HR 4072, and some other Ap stars. Abundance peaks occur at atomic masses A = 191 ± 2 on 73 Dra, at A = 201 ± 3 on HR 4072, at A = 199 ± 5 on other "main" group Ap stars, and at A = 201 ± 2 on Mn stars. Pb has a relatively low abundance on Ap stars and also in cosmic rays which have an abundance peak at A = 193 ± 3. The abundance peaks "main" group Ap stars are due to the cyclic r-process which occurred in explosions of former companion stars. Fission products of transuranic elements are recycled by further rapid neutron captures. At the end of the r-process, the high neutron flux decreases gradually so that the final β-decays take place in a neutron-rich environment; super-heavy elements ($Z \geq 110$) formed in the r-process may be partly destroyed by neutron-induced fission. The pulsar remnants of the explosions accelerate r-process elements to cosmic-ray energies. The peak at $A \sim 201$ on Mn stars is discussed briefly. (auth)

6577 VARIATIONAL PRINCIPLE FOR WAVE PROPAGATION IN RANDOM MEDIA. Lerche, I. (Univ. of Chicago). Astrophys. Space Sci.; 15: No. 2, 206-213(Feb 1972).

A variational integral appropriate for discussing the "eigenvalues" of the exact probability equation describing wave propagation in a turbulent medium is set up. It is demonstrated that: (i) Extremal variations of the integral with respect to an adjoint probability field gives the probability equation (which is not self-adjoint) relevant to wave propagation in the random medium. (ii) Extremal variations of the integral with respect to the probability field gives the adjoint probability equations. (iii) Extremal variations of the integral with respect to trial functions for both the probability field and its adjoint gives a variational principle for calculating the normal mode eigenvalues describing wave propagation in the turbulent medium. The power and accuracy of the variational approach is illustrated by several examples. (auth)

6578 EVOLUTION OF 1.40 M_θ PURE He STAR. Shaviv, G.; Vidal, N. (Tel Aviv Univ., Ramat Aviv, Israel). Astrophys. Space Sci.; 15: No. 2, 195-205(Feb 1972).

The evolution of a 1.40 M_θ pure He star is calculated from the stage of the ignition in the center up to the very advanced stage of evolution where mass ejection by the very luminous He shell could occur. It is found that ^{12}C does not ignite by a modest margin. Subsequent evolution and relation to the central stars of planetary nebulae is discussed. (auth)

6579 EARLY EVOLUTION OF STARS. II. Strom, S. E.; Strom, K. M. (Kitt Peak National Observatory, Tucson, AZ). Sky Telesc.; 45: No. 6, 359-361(Jun 1973).

The early evolution of stars is discussed in terms of the physical properties of circumstellar envelopes and the FU Orionis phenomenon. (WDM)

6580 STELLAR ACTIVITY CYCLES. Durney, B. R.; Stenflo, J. O. (National Center for Atmospheric Research, Boulder, CO). Astrophys. Space Sci.; 15: No. 2, 307-312(Feb 1972).

The relation between the average magnetic field B, the angular velocity Ω, and the period P of stellar activity cycles is studied. For the calculations Leighton's (1969) model for the solar cycle was used with the additional assumption that the differential rotation and the cyclonic turbulence (Parker, 1955) (that is the "sunspot tilt" or the "α-effect") are both proportional to Ω. It was found that B is roughly proportional to Ω and that P decreases with increasing Ω. The period of the solar cycle increases therefore with the age of the Sun. (auth)

6581 BLUE OBJECTS. Richter, N. Jena Rev.; No. 7, 322-326(1972).

The physical classification of O and B stars, white-dwarf stars, and quasars by the use of the two-color diagram is considered. (WDM)

6582 OBSERVATIONAL EVIDENCE RELATING TO A RECENT THEORY ON THE ORIGIN OF THE UNIVERSAL X-RAY BACKGROUND. Mack, J. E. (Univ. of Houston, TX); Robbins, D. E. Astrophys. Space Sci.; 16: No. 2, 336-337(May 1972).

It has recently been suggested (Ray Chaudhuri and Bandyopadhyay 1971) that the universal x-ray background can be explained as the sum of thermal emission from neutron stars less than 100 yr of age. It is pointed out that a considerable body of observational evidence weighs against the proposed model. (WDM)

6583 STUDIES OF BLUE OBJECTS AT HIGH GALACTIC LATITUDES. Faint Blue Objects in the Field of BD + 29°2348 (the Galactic North Pole). Barbieri, C.; Rosino, L. (Astronomical Observatories of Padua and Asiago, Italy). Astrophys. Space Sci.; 16: No. 2, 324-335(May 1972).

Continuing the survey for faint blue objects at high galactic latitudes, a field of 25 square degrees centered at the Coma Cluster of galaxies was examined on two-color plates taken with the 90-67 cm Schmidt telescope of Asiago. 487 objects were identified. A selected list of those with the largest negative color index is given. Identification charts, notes and comments follow. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 6581 and 6622.

6584 (NP-19745) PULSAR RADIO EMISSION MECHANISM. Virtamo, J.; Jauho, P. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). [1971]. 37p. Dep. NTIS (U.S. Sales Only) $4.00.

The radio emission model first proposed by Chiu and Canuto is considered further. An assumption made for this particular model is that radiation is due to induced electron bremsstrahlung in an intense magnetic field as the electrons flow, accelerated by an electric field. The bremsstrahlung emission rate used includes an arbitrary direction of photon propagation. The macroscopic radiation pattern is calculated, taking into account the refraction of rays. The narrow, hollow beam of radiation which results from this model semiquantitatively reproduces some of the characteristic features of pulsar radiation. (auth)

6585 ACCURATE FLUX DENSITIES AT 8.87 GHz OF 195 RADIO SOURCES. Shimmins, A. J.; Wall, J. V. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Aust. J. Phys.; 26: No. 1, 93-109(Feb 1973).

Accurate flux densities at 8.87 GHz were determined with the Parkes 64 m telescope for 195 radio sources, using an on–off integration method. The sources were selected from the Parkes 408 and 2700 MHz catalogues as those having estimated flux densities at 8.87 GHz greater than 0.5 f.u. and relatively small angular sizes. Eighty of the selected sources were identified with QSO's, 40 with galaxies, and one with an H II region, while 74 were not identified. The estimated accuracy of the flux density was ±0.02 f.u. (r.m.s.) due to system noise and ±3.5% due to other causes. A list of known or newly suspected radio variables in the sample is given. (auth)

6586 DEPOLARIZATION IN FLAT-SPECTRA QUASARS. Pacholczyk, A. G.; Gregory, S. A. (Univ. of Arizona, Tucson). Mon. Notic. Roy. Astron. Soc.; 161: No. 4, 31P-34P(1973).

It is shown that the wavelength dependence of integrated polarization typical of a composite flat spectrum radio source can be represented as resulting from a superposition of components with polarization spectra similar to those of steep-spectra objects. Therefore there is no need to assume that flat-spectra sources have intrinsically lower Faraday dispersion than steep-spectra sources. Also, the supposition that quasars at a distant cosmological epoch contain, or are surrounded by, a larger mass of plasma than the nearer ones is not a necessary interpretation of available polarization data. (auth)

6587 CYCLICITY OF OPTICAL VARIATIONS OF 3C 273. Chertoprud, V. E.; Gudzenko, L. I.; Ozernoi, L. M. (Moscow Inst. of Physics). Nature (London) Phys. Sci.; 242: No. 118, 70-71(2 Apr 1973).

Reference is made to Wheeler (Nature Phys. Sci. 237 : 102 (1972)) who discussed the present authors' method for the analysis of the optical variability of 3C 273, but came to different conclusions. The aim here is to establish the reasons for this difference. The chief disagreement refers to the problem of whether or not there are any grounds to suppose that a significant cyclic component with a mean period $T \approx 10$

yr. is present in the optical variability of this quasar. The answer is positive, whereas that of Wheeler is negative. (UK)

6588 PARTICLE INJECTION IN THE CYGNUS X-3 RADIO OUTBURST. Peterson, F. W. (National Radio Astronomy Observatory, Charlottesville, VA). Nature (London); 242: No. 5394, 173-177(16 Mar 1973).

It is stated that particle injection played an important role in the recent Cygnus X-3 radio outburst. Calculations of the basis of an improved expanding cloud model show that a maximum mass of 0.76×10^{-8} $M_\odot$ was injected over a period of 1.2 days. (auth)

6589 RADIO EMISSION FROM PULSARS AND SURFACE TEMPERATURE OF NEUTRON STARS. Rengarajan, T. N. (Tata Inst. of Fundamental Research, Bombay). Nature (London) Phys. Sci.; 242: No. 120, 102-104(16 Apr 1973).

It is generally believed that neutron stars are the central objects responsible for radio emission from pulsars, but so far there has not been any direct observational evidence for the presence of neutron stars. Neutron stars are believed to be formed with surface temperatures of 10^{7}°K or more. Because of the difficulties of direct experimental evidence it is stated to be worthwhile to consider other ways of estimating or putting limits on the temperature of neutron stars, and it is suggested that the interaction between the blackbody photons emitted from the surface and the electrons responsible for radio emission from pulsars may provide such a means. Beyond a certain temperature the density of blackbody photons will be high enough to degrade the electrons by Compton scattering, thus suppressing radio emission. Various models for understanding radio emission from pulsars have been proposed, most of which require the presence of a high density of energetic electrons. The most attractive model is stated to be the coherent curvature radiation model first proposed by Rodhakrishman (Nature 221:443(1969)), in which bunches of electrons travelling along the curved magnetic field lines give rise to radio emission due to the acceleration involved in bending. This model was developed further by others, and it has been suggested that conditions for bunching are facilitated by the presence of currents of electrons and positrons resulting from the cascading of γ rays produced by very high-energy electrons curving along the magnetic field lines. In the discussion it is assumed that the radio emission from pulsars is due to bunches of electrons streaming from the polar caps along the magnetic field lines, and the interaction between these electrons and the blackbody photons emitted from the surface is investigated. (UK)

6590 RESULTS AND PROBLEMS IN THE INVESTIGATION OF THE SYNCHROTRON INSTABILITY. Zheleznyakov, V. V.; Suvorov, E. V. (Scientific Radiophysical Research Inst., Gorky, USSR). Astrophys. Space Sci.; 15: No. 1, 24-43(Jan 1972).

A brief resume of the results of the linear theory of the synchrotron instability is presented, obtained using the quantum method with the Einstein coefficients and the classical method with the kinetic equation. The full equivalence is shown for the results of quantum and classical treatment of synchrotron instability. The expression for the growth-rate of synchrotron radiation in a system of relativistic electrons with an anisotropic momentum distribution is also found and investigated. Such a distribution might be realized in certain sources of cosmic radio emission (for example in pulsars). Certain problems are noted which have not yet been properly solved in studies of the synchrotron instability (the instability of a highly rarified plasma, the quasi linear theory of the synchrotron instability, and so on). (auth)

6591 CIRCULAR POLARIZATION OF SYNCHROTRON RADIATION IN THE PRESENCE OF HYDROMAGNETIC WAVES. Seaquist, E. R. (Univ. of Toronto, Richmond Hill, Ont.). Astrophys. Space Sci.; 15: No. 2, 284-292(Feb 1972).

It is shown that relativistic electrons in the presence of circularly polarized hydromagnetic waves emit synchrotron radiation which is partially circularly polarized. The relation between the degree of polarization of the radiation and the energy density and wavelength of the waves is derived, and the factors determining the sense of polarization are discussed. Waves of the type required are generated by pitch angle anisotropies in a relativistic electron gas. An application of the result to conditions expected in quasistellar objects shows that the degree of circular polarization of synchrotron radiation in these objects may be of order 1% or greater. (auth)

6592 MASS AND ANGULAR MOMENTUM LOSSES FROM SPINARS. Anand, S. P. S.; Shara, M. M. (Univ. of Toronto). Astrophys. Space Sci.; 16: No. 2, 171-178(May 1972).

Mestel's stellar wind theory is applied to estimate the mass and angular momentum losses for the recently proposed spinar model of quasars. If a spinar is uniformly rotating and has temperatures in the corotating regions of over a billion degrees, then it is found that all the rotational energy will be lost in 10^{3} yr. This time scale is much shorter than the total life time of the spinar model which is about 10^{6} yr. Hence it is suggested that the temperatures of the corotating regions of spinars must be less than a billion degrees. (auth)

Solar Phenomena

Refer also to abstracts 6580, 6634, and 6668.

6593 (N-73-11814) SOLAR FLARE PREDICTIONS AND WARNINGS. Final Report. White, K. P. III (Aerospace Corp., El Segundo, Calif. Space Physics Lab.). 1 Oct 1972. Contract NAS2-6654. 40p. (NASA-CR-114511; ATR-73(7265)-1). NTIS.

The real-time solar monitoring information supplied to support SPARCS equipped rocket launches, the routine collection and analysis of 3.3-mm solar radio maps, short-term flare forecasts based on these maps, longer-term forecasts based on the recurrence of active regions, and an extension of the flare forecasting technique are summarized. Forecasts for expectation of a solar flare of class ≥2F are given and compared with observed flares. A total of 52 plage regions produced all the flares of class ≥1N during the study period. The following results are indicated: of the total of 21 positive forecasts, 3 were correct and 18 were incorrect; of the total of 31 negative forecasts, 3 were incorrect and 28 were correct; of a total of 6 plage regions producing large flares, 3 were correctly forecast and 3 were missed; and of 46 regions not producing any large flares, 18 were incorrectly forecast and 28 were correctly forecast. (STAR) (auth)

6594 (N-73-11815) SOLAR FLARE FORECASTS BASED ON MM WAVELENGTH MEASUREMENTS. White, K. P. III (Aerospace Corp., El Segundo, Calif. Space Physics Lab.). 25 Oct 1972. 40p. (NASA-CR-114510; ATR-73(8102)-4). NTIS.

Solar radio temperature contour maps at a wavelength of 3.3 mm are analyzed to develop a method of forecasting solar flares of classes 1N and 1B. Fundamental to the analysis is the demonstration that most of the radio sources associated with the sunspot-plage systems are not spatially resolved by the radio telescope and, hence, only the peak temperature enhancements due to these local radio sources are employed. Evidence is presented indicating that flare-prone plage regions, which belong to recurrent families of flare-productive regions, exhibit a relationship between flare production and radio temperature characteristics considerably unlike that exhibited by virgin plage regions. The results are interpreted by means of graphs which permit the inference of class 1B or 1N flare probabilities based on the peak temperature enhancements measured at 3.3 mm. In particular, the forecast obtained is the probability that a given flare-prone plage region will produce a class 1B or 1N flare (two quoted probabilities) during the period of its disk transit. (STAR) (auth)

6595 (NP-19732) CORRECTION OF OBSERVED PENUMBRAL INTENSITIES FOR SCATTERED LIGHT. Maltby, P.; Staveland, L. (Oslo Univ. (Norway). Institutt for Teoretisk Astrofysikk). 1972. 13p. Dep. NTIS (U.S. Sales Only) $3.00.

A simple method for correcting the observed penumbral intensities for light scattered in the atmosphere and the instrument is described. The correction is found to be proportional to the relative intensity at a fixed position outside the solar limb. The proportionality factor depends on the observing wavelength as well as the intensity gradient of the aureole. (auth)

6596 (NP-19735) CORRECTION OF SOLAR INTENSITY MEASUREMENTS FOR STRAY LIGHT. Staveland, L. (Oslo Univ. (Norway). Institutt for Teoretisk Astrofysikk). 1972. 35p. Dep. NTIS (U.S. Sales Only) $3.75.

A computer program is described which corrects the observed intensity in the center of an elliptical sunspot for stray light. The program also corrects the observed intensity profile of the solar limb. The analytical expression used for the relative solar limb darkening gives three to four correct digits for the Harvard–Smithsonian Reference Atmosphere (HSRA) model in the wavelength region 0.3 μm to 5.0 μm for $\cos\theta = 0.1$ to $\cos\theta = 0.3$. (auth)

6597 RELATIVE INTENSITIES OF NITROGEN LINES IN THE SEMI-CORONAL REGIME. Cilliers, W. A.; Hey, J. D.; Rash, J. P. S. (Univ. of Cape Town). J. Plasma Phys.; 9: No. 1, 77-88(Feb 1973).

A number of nitrogen spectral lines were studied at an electron density of about 10^{16} cm^{-3}, and the results are discussed with reference to the LTE and semi-coronal models. A method is suggested for analyzing line intensity ratio data from plasmas in the semi-coronal regime. (auth)

6598 SOLAR STORM THAT SHOOK THE WORLD. Gribbin, J. New Sci.; 58: No. 845, 339-340(10 May 1973).

The great solar storm of August 1972 produced a measurable effect on the spin of the Earth, changing the length of the day and the rate at which the Earth's spin is slowing down. (auth)

6599 COMPOSITION OF ENERGETIC SOLAR PARTICLES. Biswas, S. Indian J. Radio Space Phys.; 1: No. 1, 19-24(1972).

The present state of knowledge on the composition of energetic solar particles is reviewed with particular reference to the direct measurements of these particles with sounding rockets and balloons during solar cosmic-ray events. The observational data on the energy spectra and relative abundances of hydrogen, helium, and heavy nuclei measured at different times during a number of solar events are discussed in order to delineate the characteristic features of solar cosmic rays. The implications of these results are discussed in relation to the propagation of solar cosmic rays, the relative abundances of elements in the Sun and the composition of galactic cosmic rays. It is shown that the relative abundances of multiply charged nuclei measured in solar cosmic rays represent an unbiased sample of these nuclei from the Sun and hence the photospheric abundances of helium, carbon, nitrogen, oxygen, neon and iron group, are now obtained from solar cosmic rays. By combining the ratio of helium to oxygen measured in solar cosmic rays with that of hydrogen to oxygen obtained by spectroscopic means, the hydrogen to helium ratio in the sun is determined as 16 + 2. A comparison of the composition of energetic solar particles with that of galactic cosmic rays reveals some striking differences; this indicates that ordinary stars like the Sun cannot be the main source of cosmic rays. (49 references) (ISA)

6600 GENERATION OF HIGH-ENERGY PARTICLES IN SOLAR FLARES. Sakurai, K. (Goddard Space Flight Center, Greenbelt, MD). Planet. Space Sci.; 21: No. 5, 793-798(May 1973).

The relationship between some characteristics of microwave Type IV radio bursts and solar cosmic-ray protons of MeV energy is discussed. It is shown that the peak flux intensity of those bursts is almost linearly correlated with the MeV proton peak flux observed by satellites near the Earth and that protons and electrons would be accelerated simultaneously by a similar mechanism during the explosive phase of solar flares. Brief discussion is given on the propagation of solar cosmic rays in the solar envelope after ejection from the flare regions. (auth)

6601 KINETIC MODELS OF THE SOLAR AND POLAR WINDS. Lemaire, J.; Scherer, M. (Inst. for Space Aeronomy, Brussels). Rev. Geophys. Space Phys.; 11: No. 2, 427-468(May 1973).

The application of the kinetic theory to the collisionless regions of the polar and solar winds is discussed. A brief historical review is given to illustrate the evolution of the theoretical models proposed to explain the main phenomenon and observations. The parallelism between the development of the solar wind models and the evolution of the polar wind theory is stressed especially. The kinetic approaches were in both cases preceded by the hydrodynamic models, and their publication gave rise to animated controversies; later on, semikinetic and hydromagnetic approximations were introduced. A kinetic method, based on the quasi neutrality and the zero current condition in a stationary plasma with open magnetic field lines, is described. The applicability of this approach on the solar and polar winds is illustrated by comparison of the predicted results with the observations. The kinetic models are also compared with hydrodynamic ones. The validity of the criticism and remarks uttered during the Chamberlain–Parker controversy (for the solar wind), and the dispute between Banks and Holzer on the one hand, and Dessler and Cloutier on the other (for the polar wind), are carefully analyzed. The main result of this study is that both approaches are in fact not contradictory but complementary. The classical hydrodynamic descriptions are only appropriate in the collision-dominated region, whereas the kinetic theory can be applied only in the collision-free domain. (auth)

6602 SOLAR ACTIVITY. Tandberg-Hanssen, E. (High Altitude Observatory, Boulder, CO). Rev. Geophys. Space Phys.; 11: No. 2, 469-504(May 1973).

The changes in the Sun's surface and atmosphere, normally referred to as solar activity, are intimately linked to the production, transport, and dissipation of magnetic fields. The most obvious manifestations of the changes are sunspots, flares, and the changing corona. The complex of solar activity can be divided into two parts: (1) the problem of the generation of magnetic fields and of the solar cycle (the 11-year period) and (2) the surface manifestations of solar activity. The first problem concerns the solar dynamo, and dynamo maintenance is discussed in some detail. In particular, it is shown that a combination of differential rotation of the outer parts of the Sun and cyclonic turbulence of the solar plasma constitutes a very efficient system for generation of magnetic fields. When these fields are transported to the Sun's surface, they interact with the motions of the atmospheric plasma to produce the manifestation of solar activity; plages, sunspots, flares, prominences, and the active corona. Models of plages and several types of prominences are discussed, and the first steps toward theories for solar flares are indicated. The role of the magnetic fields, either as a supporting agent to store energy or as an energy source (field annihilation), cannot be overemphasized. Prominence formation and stability, as well as the occurrence of different types of flares, are treated in some detail. A discussion is given of the active corona and interaction of the coronal plasma with other types of activity (flares and active prominences). (auth)

6603 MAJOR VARIATIONS IN SOLAR LUMINOSITY. Cameron, A. G. W. (Yeshiva Univ., New York). Rev. Geophys. Space Phys.; 11: No. 2, 505-510(May 1973).

One possible explanation for the failure to detect neutrinos emitted from the solar interior is that the core of the Sun may be in a temporarily expanded state. If so, the solar luminosity is currently much less than its normal value, which may account for the fact that the Earth is now in the middle of a major glacial period. The astrophysical background of this situation is described, and the terrestrial consequences are discussed. (auth)

6604 SOLAR PARTICLE ACCESS TO THE MAGNETOSPHERE: HOW. Lanzerotti, L. J. (Bell Telephone Labs., Murray Hill, NJ); Michel, F. C. Comments Astrophys. Space Phys.; 4: No. 6, 161-165(1972).

The use of solar particles as tracers of the Earth's geomagnetic field in order to study the possible interconnection of the geomagnetic field and the local interplanetary field is considered. Observations supporting both the open and closed models are reviewed. (WDM)

6605 EVIDENCE FOR OBJECTS OF LUNAR MASS IN THE EARLY SOLAR SYSTEM AND FOR CAPTURE AS A GENERAL PROCESS FOR THE ORIGIN OF SATELLITES. Urey, H. C. (Univ. of California, San Diego, La Jolla). Astrophys. Space Sci.; 16: No. 2, 311-323(May 1972).

The problem of the accumulation of the Moon is discussed on the assumption that the Moon is a captured object. If it is such, it is highly improbable that it is the only object of this kind present in the early solar system. Evidence indicating that other massive objects were present at that time is presented. Also, it is pointed out that the interior of the Moon must contain normal solar proportions of the elements of intermediate volatility in the lunar interior, if the Moon accumulated in a gas sphere. (auth)

6606 ASYMMETRICALLY ROTATING FLUID DISC WITH APPLICATIONS. White, M. L. (Air Force Cambridge Research Labs., Bedford, MA). Astrophys. Space Sci.; 16: No. 2, 295-310 (May 1972).

The rotation of a compressible inviscid fluid disc of (1) slowly varying density, (2) nonuniform density (cold gas approximation), or (3) nonuniform density (hot, but tenuous) is considered. Perturbation methods for solving the basic equation for conservation of vorticity are used. It is found that steady state conditions are realized when vortex waves and differential rotation (jet streams) coexist; special solutions for these vortex waves are obtained. For one of these solutions, a given jet stream and its associated vortex (only one vortex per jet allowed) wave can exist only at certain discrete "orbital" distances, given by a geometric progression A^n where n is an integer and A is a constant. This progression is a good representation for the distances of planets and satellites, with small orbital inclinations, from their respective parent bodies. Certain other solutions for the vortex wave yield streamlines that are logarithmic spirals. Some justifications are given for applying the model to the dynamics of hurricanes and spiral galaxies. Comparisons with observations are surprisingly favorable. The possible role of the jet streams and the steady state long vortex waves (a cooperative-vortex phenomenon) in the formation and evolution of the solar system is also discussed. Comparisons are made with the von Wiezsäcker (1944) and Chandrasekhar (1946) model of turbulent eddies in the solar nebula and with the particle (asteroidal) jet streams of Alfvén and Arrhenius (1970a, b). (auth)

Galaxies

6607 INTERSTELLAR MAGNETIC FIELD STRENGTH AND DIRTY ICE GRAINS ORIENTED BY PARAMAGNETIC RELAXATION. Shah, G. A. (Tata Inst. of Fundamental Research, Bombay). Astrophys. Space Sci.; 15: No. 2, 185-194(Feb 1972).

A method of estimating the orientation parameter and the resulting galactic magnetic field consistent with the observed visual ratio of polarization to extinction is given. The orientation is considered in the sense of paramagnetic relaxation envisaged by Davis and Greenstein (1951) and by Jones and Spitzer (1967). It is assumed that the grains, cylindrical in shape, consist of a pair of distinct effective sizes with different number densities. The method is applied to dirty ice grain as an illustration. (auth)

6608 CHANGES IN THE GRAVITATIONAL ENERGY OF GALAXIES DURING COLLISIONS. Sastry, K. S. (Osmania Univ., Hyderabad, India). Astrophys. Space Sci.; 16: No. 2, 284-294(May 1972).

The problem of the change in gravitational energy of a colliding galaxy due to tidal effects is considered. The change in the internal energy, the mass of escaping matter and the change in the mean radius of the test galaxy have been estimated for a relative velocity of 1000 km s^{-1} for three distances of closest approach for the following four cases: (a) both galaxies centrally concentrated, (b) both galaxies homogeneous, (c) test galaxy centrally concentrated, field galaxy homogeneous, and (d) test galaxy homogeneous, field galaxy centrally concentrated. The masses and radii of the two galaxies are taken as 10^{11} $M_{\odot}$ and 10 kpc respectively. For simplicity, the galaxies are assumed to be spherically symmetric and the distribution of mass within a centrally concentrated galaxy is assumed to be that of a polytrope of index $n = 4$. The results also provide estimates for the minimum relative velocity a galaxy must have in order that it may not be captured by another to form a double system. It has been found that normally a relative velocity of less than about 500 km s^{-1} will lead to the formation of a double galaxy by tidal capture. In the case of a head-on collision between two centrally concentrated galaxies even a relative velocity of about 1000 km s^{-1} is small enough for tidal capture. The changes in the structure of the galaxies for relative velocities equal to velocity of escape are also indicated. These results show that there is no escape of matter from the test galaxy in cases (b) and (c). In the case (a) the escape of matter can be as high as 4% of the total mass. The head-on collision between galaxies is normally not accompanied by any escape of matter. All the gain in the internal energy of galaxies during such collisions results in increase in their dimensions. The fractional increase in the mean radius of the test galaxy in the head-on collision is 1.5 in the case (a), 3.2 in the case (b) and 0.01 in the case (c). In the case (d) the test galaxy will be disrupted by the tidal forces. (auth)

6609 NEAR RESONANT CHARGE TRANSFER PROCESSES AT THERMAL ENERGIES. Brown, R. L. (National Radio Astronomy Observatory, Green Bank, WV). Astrophys. Space Sci.; 16: No. 2, 274-283(May 1972).

A useful procedure is described for the evaluation of near resonant charge transfer cross sections at thermal energies. The method is based on a generalization of a semi-classical approach introduced by Bates and Mapleton for the study of symmetric resonant charge transfer processes. The rate coefficient is calculated for the reaction $O^+ + H \rightleftharpoons H^+ + O$ as a function of temperature between 10 and 10^{4}°K; the results are compared to those obtained using the "orbiting approximation." A brief application of these rates to the interstellar medium is made where it is found that substantial differences emerge between cases where the gas is heated by cosmic rays or by x rays. (auth)

Cosmology

6610 (N-73-12387) NEW THEORY OF GRAVITY. Ni, W. T. (California Inst. of Tech., Pasadena). [1972]. 11p. (NASA-CR-129242). NTIS.

A new relativistic theory of gravity is presented. This theory agrees with all experiments to date. It is a metric theory, it is Lagrangian-based, and it possesses a preferred frame with conformally-flat space slices. With an appropriate choice of certain adjustable functions and parameters, this theory possesses precisely the same post-Newtonian limit as general relativity. (STAR) (auth)

6611 (N-73-12893) RELATIVISTIC STELLAR STABILITY: AN EMPIRICAL APPROACH. Ni, W. T. (California Inst. of Tech., Pasadena). [1972]. 33p. (NASA-CR-129241). NTIS.

The PPN formalism which encompasses the post-Newtonian limit of nearly every metric theory of gravity is used to analyze stellar stability. This analysis enables one to infer, for any given gravitation theory, the extent to which post-Newtonian effects induce instabilities in white dwarfs, in neutron stars, and in supermassive stars. It also reveals the extent to which our current empirical knowledge of post-Newtonian gravity (based on solar-system experiments) actually guarantees that relativistic instabilities exist. In particular, it shows that: (1) for conservative theories of gravity, current solar-system experiments guarantee that the critical adiabatic index, for the stability of stars against radial pulsations exceeds the Newtonian value of 4/3 and (2) for nonconservative theories, current experiments do not permit any firm conclusion about the sign of the critical adiabatic index, and (3) in the PPN approximation to every metric theory, the standard Schwarzschild criterion for convection is valid. (STAR) (auth)

6612 NUCLEOSYNTHESIS IN THE SYMMETRIC UNIVERSE. Schatzman, E. Comments Astrophys. Space Phys.; 5: No. 1, 23-28(1973).

New developments of the theory of matter-antimatter symmetric Universe have introduced a different picture of nucleosynthesis. This theory's bearing on nucleosynthesis is discussed. This could provide a critical test of the theory, together with the two other quantities for which it should in principle give a definite prediction: the ratio between the number of hydrogen atoms and thermal photons and the spectrum of inhomogeneities associated with galaxy formation. (WDM)

6613 COSMOLOGICAL SIGNIFICANCE OF e^2/Gm^2 AND RELATED LARGE NUMBERS. Rees, M. J. (Inst. of Astronomy, Cambridge, Eng.). Comments Astrophys. Space Phys.; 4: No. 6, 179-185(1972).

Interrelations between the fundamental constants of microphysics and cosmological geometry and quantities are considered in some detail. (WDM)

6614 PARTICLE BARRIERS IN COSMOLOGY. Harrison, E. R. (Univ. of Massachusetts, Amherst). Comments Astrophys. Space Phys.; 4: No. 6, 187-192(1972).

It is argued that the Bahcall–Frautschi hadron barrier probably does not exist. The proposed mechanism of filtering out low-mass hadrons, thus allowing higher-mass hadrons of diminished size to penetrate the pion and other particle-size barriers, is purely speculative. (WDM)

6615 OBSERVATION OF RELIC RADIATION AS A TEST OF THE NATURE OF X-RAY RADIATION FROM THE CLUSTERS OF GALAXIES. Sunyaev, R. A.; Zeldovich, Ya. B. (Inst. of Applied Mathematics, Moscow). Comments Astrophys. Space Phys.; 4: No. 6, 173-178(1972).

It is assumed that clusters of galaxies form an important class of powerful x-ray sources, possibly giving the main contribution to the x-ray background radiation of the Universe. The nature of these sources and the physical mechanisms responsible for the observed x-ray radiation are considered. (WDM)

6616 CASE FOR A CHAOTIC COSMOGONY. Silk, J. (Univ. of California, Berkeley). Comments Astrophys. Space Phys.; 5: No. 1, 9-14(1973).

A brief exposition of a scheme for manufacturing galaxies in the context of Einstein's theory that is relatively insensitive to the choice of initial conditions. (WDM)

6617 EXACT COSMOLOGICAL SOLUTIONS IN BRANS AND DICKE'S SCALAR–TENSOR THEORY. II. Dehnen, H.; Obregon, O. (Univ., Konstanz, Ger.). Astrophys. Space Sci.; 15: No. 2, 326-33(Feb 1972).

In addition to a previous paper (Dehnen and Obregon, 1971) the exact cosmological solutions of Brans and Dicke's scalar–tensor theory allowing a power law between the gravitational constant K and the radius of curvature R of the Universe are sought in case that the initial condition $R(t = 0) = 0$ is avoided. There exist two different types of solutions especially for the closed space of positive curvature and for positive values of the freely available parameter ω of the scalar–tensor theory. The radius of curvature and also the gravitational constant increase at first with respect to time and decrease after reaching a maximum value, in contradiction to Dirac's hypothesis whereafter the gravitational constant should decrease with time in an expanding Universe. The age of the Universe following from these solutions is in accordance with the observations. (auth)

6618 DERIVATION OF THE DIFFERENTIAL EQUATION FOR THE SIMPLER COSMOLOGICAL MODELS. Landsberg, P. T. (Univ. of Southampton, Eng.). Nature (London) Phys. Sci.; 242: No. 120, 104(16 Apr 1973).

Reference is made to the simplified expositions of cosmology that have been published during the past few years, and it is stated that an even simpler approach may be formulated, dispensing with difficulties associated with a continuous distribution of matter and the assumption of precise homogeneity and isotropy. (UK)

6619 GALACTIC FORMATION MODEL BASED ON POST-BIG BANG FRAGMENTATION. Brown, W. K. (Univ. of Wyoming, Laramie). Astrophys. Space Sci.; 15: No. 2, 293-306(Feb 1972).

A new model of galactic formation is presented. A primeval distribution of angular momentum is derived, which rests on the postulated presence of mass flows at the early stage of the post-big bang universal expansion, when fragmentation occurs. The shape of any particular fragment and its orientation with respect to the mass flow predestine the morphology of the galaxy that will be produced in the subsequent collapse. A fragment-to-disk mapping transform allows examination of the galactic disk mass distributions that result from the postulates of the model. One class of distribution describes the observed luminosity profiles of elliptical galaxies. Another class indicates the allocation of a large mass fraction to an extended disk, and the intrinsic two-sided symmetry of the model further indicates that the disk formation process will begin with the establishment of two major spiral arms. (auth)

6620 FLYING CLOCKS AND THE SAGNAC EFFECT. Schlegel, R. (Michigan State Univ., East Lansing). Nature (London); 242: No. 5394, 180(16 Mar 1973).

Reference is made to the Hafele and Keating "flying clock" experiment (Science 177: 168 (1972)), in which was observed an on-Earth directional dependence of the relativistic time dilation. The present author argued that such a dependence is contrary to special relativity theory (Nature Phys. Sci. 229: 237 (1971)), but in view of the fact that the effect is essentially one involving accelerated motion now recognizes that his neglect of this fact invalidates his argument. Nevertheless a seeming inconsistency arises in considering the clocks from the Earth reference frame. If two similar clocks are moving on equatorial paths with equal speeds relative to the Earth, one westward and the other eastward, they should have equal time rates and equal kinetic energies in the Earth system. In actual fact they do have equal energies, but not equal time rates. If, however, the Sagnac effect (Compt. Rend. 157: 708 (1915)) is taken into account in the synchronization of clocks in the Earth frame the contradiction disappears. This is analyzed mathematically. (UK)

6621 ANISOTROPIC SOLUTION OF THE GRAVITATION EQUATIONS WITH AN ISOTROPIC SINGULAR HYPERSURFACE. Pinus, V. K. (Inst. of Automation and Electrometry, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 64: No. 4, 1111-1118(Apr 1973). (In Russian).

A broad class of anisotropic solutions of the gravitation equations possessing an isotropic singular hypersurface is found in the case of an extremely rigid equation of state. Seven physically arbitrary functions of the space coordinates are contained in the solution. Matter exerts an appreciable influence up to the point of collapse. It is pointed out that a similar class of solutions is contained only in space filled with matter. The energy density grows infinitely during collapse. (auth)

6622 COSMOLOGICAL INFORMATION FROM SURVEYS OF RADIO SOURCE SPECTRA. Fanaroff, B. L.; Longair, M. S. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 4, 393-407(1973).

The problem of relating the spectral index distributions of radio sources at different frequencies and flux densities is discussed in terms of evolutionary world models which incorporate strong evolution of the radio source population. It is shown that even in the simplest world models significant changes with flux density in the spectral index distributions are expected in high-frequency surveys. Such variations have recently been observed and suggest that the spectral properties of the radio source population can be described by a spectral index function which is independent of luminosity and redshift at a low frequency. The implications of this result for source counts at different frequencies and for the identifications of radio sources are discussed. (auth)

6623 CHRONOMETER FOR S-PROCESS NUCLEOSYNTHESIS. Blake, J. B.; Lee, T.; Schramm, D. N. (Aerospace Corp., Los Angeles). Nature (London) Phys. Sci.; 242: No. 120, 98-100 (16 Apr 1973).

The importance of the short-lived s-process chronometer ^{205}Pb, its relation to the mechanism of s-process nucleosynthesis and its implications for cosmochronology are discussed. (auth)

Planetary Phenomena

Refer also to abstract 5766.

6624 (AERE-PR/NP-18, pp 51-53) LUMINESCENT AND THERMOLUMINESCENT PROPERTIES OF APOLLO 12 SAMPLES. Blair, I. M. (Atomic Energy Research Establishment, Harwell, Eng.); Edgington, J. A.; Jahn, R. A. Mar 1972.

6625 OXYGEN ISOTOPIC COMPOSITION OF THE LUNA 20 SOIL. Clayton, R. N. (Univ. of Chicago). Geochim. Cosmochim. Acta; 37: No. 4, 811-813(Apr 1973).

The Luna 20 soil (<125 µm fraction) has a relatively low $\delta\ ^{18}$O (5.7‰), compared to other lunar soils (5.8 to 6.3‰). This implies either a low-^{18}O source material or an unusually small ^{18}O enrichment in the process of soil formation and maturation. (auth)

6626 REFRACTORY TRACE ELEMENTS IN Ca-Al-RICH INCLUSIONS IN THE ALLENDE METEORITE. Grossman, L. (Yale Univ., New Haven). Geochim. Cosmochim. Acta; 37: No. 5, 1119-1140(May 1973).

The condensation temperatures are calculated for a number of refractory trace metals (Os, W, Zr, Re, Hf, Y, Sc, Mo, Ir, Ru, V, Ta, Th) from a gas of solar composition at 10^{-3} and 10^{-4} atm. total pressure. Instrumental neutron activation analysis of Ca-Al-rich inclusions in the Allende carbonaceous chondrite reveals enrichments of 22.8 ± 2.2 in the concentrations of Ir, Sc, and the rare earths relative to C1 chondrites. Such enrichments cannot be due to magmatic differentiation processes because of the marked differences in chemical behavior between Ir and Sc, exhibited by their distributions in terrestrial igneous rocks and meteorites. All of these elements should have condensed from a cooling gas of solar composition above or within the range of condensation temperatures of the major mineral phases of the inclusions, which suggests that these inclusions are high-temperature condensates from the primitive solar nebula. Gas-dust fractionation of these materials may have been responsible for the depletion of refractory elements in the ordinary and enstatite chondrites relative to the carbonaceous chondrites. (auth)

6627 FOSSIL TRACK AND THERMOLUMINESCENCE STUDIES OF LUNA 20 MATERIAL. Crozaz, G.; Walker, R.; Zimmerman, D. (Washington Univ., St. Louis). Geochim. Cosmochim. Acta; 37: No. 4, 825-830(Apr 1973).

Track densities in 85 feldspar crystals from L-2009 range from 2.5×10^6/cm^2 to >10^9/cm^2. This track distribution represents an intermediate case between what have been previously defined as lightly and heavily irradiated soils and suggests that the Luna 20 sample consists of a mixture of a mature, heavily irradiated component with another, lightly irradiated component. Using a two component mixing model, the age of the lightly irradiated component is ~270×10^6 yr. It is possible, but by no means certain, that this is associated with the formation of the crater Apollonius C. At ~200°C the ratio of natural TL to that induced by a standard irradiation is similar to that in Apollo 12 and 14 cores below ~7 cm. This confirms that most of the Luna 20 sample represents sub-surface material. (auth)

6628 DETECTION OF A NONUNIFORM DISTRIBUTION OF POLONIUM 210 ON THE MOON WITH THE APOLLO 16 ALPHA PARTICLE SPECTROMETER. Bjorkholm, P.; Golub, L.; Gorenstein, P. (American Science and Engineering, Inc., Cambridge, MA). Science; 180: No. 4089, 957-959(1 Jun 1973).

The polonium-210 activity of the lunar surface is significantly larger than the activity of its progenitor radon-222. This result establishes unequivocally that radon emanation from the present-day Moon varies considerably within the 21-year half-life of lead-210, the parent nuclide of polonium-210. There are large variations and well-localized enhancements in polonium-210 activity over much of the Moon's surface. (auth)

6629 INVARIANT IMBEDDING AND CHANDRASEKHAR'S PLANETARY PROBLEM OF RADIATIVE TRANSFER. Bellman, R.; Ueno, S. (Univ. of Southern California, Los Angeles). Astrophys. Space Sci.; 16: No. 2, 241-248(May 1972).

In connection with Chandrasekhar's planetary problem of radiative transfer the total scattering and the diffuse transmission functions have been discussed by several authors (cf. Chandrasekhar, 1950; van de Hulst, 1948; Sobolev, 1948; Bellman, et al., 1967; Kagiwada and Kalaba, 1971). With the aid of the Bellman-Krein formula for the resolvent kernel of the auxiliary equation governing the source function, it is shown how the invariant imbedding equations governing the diffuse scattering and transmission functions can readily be obtained. So far as is known, the Cauchy system of the functional equations for the scattering and transmission functions is new and is well-suited for the numerical computation. (auth)

6630 LUNAR COMPOSITION FROM APOLLO ORBITAL MEASUREMENTS. Adler, I.; Trombka, J. I. (Goddard Space Flight Center, Greenbelt, MD). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 24-32(Feb 1973).

Several spectrometers carried in the Service Module of the Apollo 15 and Apollo 16 spacecraft were employed for the com-

positional mapping of the lunar surface. The observations involved the measurements of secondary (fluorescent) X-rays, gamma-rays and alpha particle emissions. A large scale compositional map of over 20 percent of the lunar surface was obtained for the first time. It was possible to demonstrate interesting chemical differences between the mare and the highlands, to find specific areas of high radioactivity and to learn something about the composition of the moon's hidden side. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstract 7149.

6631 (N-73-10379) AIRGLOW AND AURORAL EXPEDITION ABOARD THE CV-990 AIRCRAFT. (Colorado Univ., Boulder). 30 Aug 1972. 35p. (NASA-CR-128392). NTIS.

The observations with a scanning spectrometer and a single channel photometer, in the wavelength interval between 3100 and 6300 angstroms, are presented for the airborne auroral expedition in November and December 1969. The instrumentation and instrument calibration are described. (STAR)

6632 (N-73-12384) AIRGLOW AND AURORAL EXPEDITION ABOARD THE CV-990 AIRCRAFT. Final Report, 1 January–28 February 1972. (Colorado Univ., Boulder). 28 Feb 1972. 23p. (NASA-CR-129511). NTIS.

The instrumentation, calibration, and data observations of the NASA airborne auroral expedition during November and December 1969 are discussed. The observed data are tabulated along with graphical illustrations of various data correlations. (STAR)

6633 (NP-19738) POSSIBILITIES FOR LARGE-SCALE BALLOON RECORDINGS OF AURORAL-ZONE X-RAY EVENTS FROM NORTHERN SCANDINAVIA TO GREENLAND, AND THEIR COORDINATION WITH GEOS SATELLITE MEASUREMENTS. Trefall, H. (Bergen Univ. (Norway). Dept. of Physics). Jan 1973. 19p. Dep. NTIS (U.S. Sales Only) $3.00.

Ways to solve the practical problems associated with large-scale simultaneous balloon recordings of auroral-zone x rays in the region from Scandinavia to eastern Greenland, caused by the paucity of land-based launching and telemetry sites, are suggested. Firstly, the long-duration flight capabilities of modern stratospheric balloons coupled with their westward drift in the summer should make it possible to perform such recordings with launchings from Scandinavian stations only. Secondly, the experimentally tested vhf radio range of a balloon-borne transmitter seems just sufficient to cover the region mentioned from land-based telemetry stations only. Thirdly, the CONSOL navigation system seems conveniently applicable for determination of balloon positions all the way from Scandinavia to Greenland. On this basis, suggestions are made for cooperative programs between balloon recordings of x rays from electron precipitation events and GEOS satellite measurements. A scheme for longitudinal shift manoeuvres of the satellite is proposed with such measurements in mind. (auth)

6634 CHARACTERISTIC RADIATION OF THE ATMOSPHERE IN THE 3.9 TO 5.2 μ REGION. Kuznechyk, A. P. (Bellorussian State Univ., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 1, 113-116(1973). (In Belorussian).

Equations are proposed that describe the spatial distribution of energy intensity, caused by the characteristic atmospheric radiation, and conforming to a clear day or night sky outside of the limits of a solar corona in the "window of transparency" of the atmosphere, 3.9 to 4.2 and 4.5 to 5.2 μ. (tr-auth)

6635 GLOBAL VIEW AT THE POLAR REGION ON 18 DECEMBER 1971. Anger, C. D.; Lui, A. T. Y. (Calgary Univ., Alberta). Planet. Space Sci.; 21: No. 5, 873-878(May 1973).

The ISIS-2 scanning auroral photometer surveyed the polar region during three successive passes on December 18, 1971, at times when K_p values were still high due to an intense magnetic storm which began on December 16. Two very bright (IBC III) auroral substorm patterns were seen to correspond to rather weak magnetic substorms (about 300 γ in magnitude). A large spiral auroral pattern, with intensity of the order of 100 kR and a size of about 1300 km, was present in the polar cap; it gradually decreased in size and intensity during the interval 0200 to 0600 UT. A region of enhanced 3914 emission was present in the noon sector of the auroral oval between 0200 and 0400. The presence of the diffuse auroral belt was also evident at all local times during this period, extending down to about 61° corrected geomagnetic latitude in the midnight sector. (auth)

6636 EXCITATION OF ATOMIC OXYGEN TO THE $O(^1S)$ LEVEL BY ENERGY TRANSFER FROM $N_2(A^3\Sigma_u^+)$ MOLECULES IN AURORA. Henriksen, K. (Auroral Observatory, Tromsoe, Norway). Planet. Space Sci.; 21: No. 5, 863-871(May 1973).

The part that the energy transfer reaction $N_2(A^3\Sigma_u^+) + O(^3P) \rightarrow N_2(X^1\Sigma_g^+) + O(^1S)$ plays in the excitation of the auroral green line has been investigated. The contribution is estimated to be 40% in this case, containing pulsating aurora in class IBC 1. Due to greater quenching of the $A^3\Sigma_u^+$ state, the centroid of the VK emission is displaced 10 km upwards of the green line height, which is centred at 110 km. (auth)

6637 DIFFUSE AURORA. Lui, A. T. Y.; Perreault, P.; Akasofu, S. I. (Univ. of Alaska, College). Planet. Space Sci.; 21: No. 5, 857-861(May 1973).

A study of ground-based all-sky photographs substantiates the presence of the diffuse auroral belt as seen by the ISIS-2 (polar orbiting satellite) scanning auroral photometer. The intensity of the diffuse aurora increases when discrete auroras become active; in particular the diffuse aurora is most clearly seen equatorward of westward travelling surges. However, in the morning sector, it may or may not be detectable near eastward drifting patches in all-sky photographs. Some of what has been previously identified visually and in all-sky photographs as the proton aurora probably is a part of what is identified here as the diffuse aurora. The diffuse aurora appears sometimes to branch out into two, one along the auroral oval and the other along a constant geomagnetic latitude circle. The latter probably corresponds to the mantle aurora and the drizzle zone precipitation. (auth)

6638 ELECTROJET MEASUREMENTS FROM SATELLITE AND GROUND. Osborne, D. G. (University Coll., London). J. Atmos. Terrest. Phys.; 35: No. 6, 1273-1279(Jun 1973).

Comparisons between POGO electrojet profiles and the difference between the H variation at Huancayo and that at Pilar showed good correlation for 11 selected passes. The ratio of this surface enhancement of H due to the electrojet to the estimated amplitude at a mean satellite altitude of 500 km for these cases was 4.6 ± 0.4. Similar ratios over India and the Philippines for different satellite altitudes were 7.1 ± 0.6 and 5.0 ± 0.7, respectively. The width of the electrojet profile in the POGO data at Huancayo was interpreted in terms of the classical band current model with the resulting image depth of 625 ± 100 km, current width of 520 ± 50 km and average current intensity of 112 A/km. (auth)

6639 CORRELATION OF THE GROUND DATA AT IBADAN WITH POGO SATELLITE RESULTS. Oni, E. (Univ. of Ibadan, Nigeria). J. Atmos. Terrest. Phys.; 35: No. 6, 1267-1271(Jun 1973).

POGO satellite data are compared with the ground data at Ibadan. Results show poor correlation. The ratio Ground/POGO obtained from the scatter diagrams and extrapolated to the value on the jet axis is compared with other ratios from India, Addis Ababa, and Huancayo. The variation in the ratios from different zones is discussed in the light of the results of the preliminary work on the upper mantle conductivity structure in Nigeria. It is concluded that the conventional model of image plane approximation used by Chapman and others in deducing the induction part of the electrojet is unrealistic in the face of recent results of Solid Earth Physics study. (auth)

6640 CORRELATION OF SATELLITE ESTIMATES OF THE EQUATORIAL ELECTROJET INTENSITY WITH GROUND OBSERVATIONS AT ADDIS ABABA. Gouin, P. (Univ. of Addis Ababa). J. Atmos. Terrest. Phys.; 35: No. 6, 1257-1264(Jun 1973).

Of the 2000 OGO-4 and OGO-6 equatorial passes, 112 were within 10° either side of Addis Ababa. Twenty-five passes happened during magnetically quiet periods when the index $a_p \leq 4$. Correlations were sought between the effect of the equatorial electrojet at satellite altitude and ground measurements. When the ground values ΔH (AA) were read at the LT corresponding to the local time at the longitude of the satellite, the correlation is very good for 80% of the observations. The inverse slope of the ground effect versus satellite effect is about 3.8 for Addis Ababa. A ΔH (AA) threshold of about 40 gammas was found below which the satellite did not register any electrojet effect. Some observations with excessive residuals correspond to H (AA) traces of irregular shapes; others cannot be explained unless one postulates the existence of nonelectrojet ionospheric currents which distort the magnetic field at satellite height much more than at the surface of the Earth. (auth)

6641 ELECTROJET FIELD FROM SATELLITE AND SURFACE OBSERVATIONS IN THE INDIAN EQUATORIAL REGION. Yacob, A.; Bhargava, B. N. (Indian Inst. of Geomagnetism, Bombay). J. Atmos. Terrest. Phys.; 35: No. 6, 1253-1255(Jun 1973).

The amplitudes of jet signature, ΔF, from POGO observations over the Indian equatorial zone from 60° to 95°E are compared with ΔH at the two equatorial stations, Trivandrum and Annamalainagar and Alibag which is outside the electrojet. (auth)

6642 SOLAR AND LUNAR TIDAL EFFECTS ON THE LOW-LATITUDE IONOSPHERE. A Review. Matsushita, S. (High Altitude Observatory, Boulder, CO). J. Atmos. Terrest. Phys.; 35: No. 6, 1027-1034(Jun 1973).

After a brief review of neutral atmospheric tidal winds and the electrostatic field produced by them in the ionosphere, effects of those winds and fields on the ionosphere, particularly F2 and E_s, are discussed. The review is limited to recent studies made since the previous equatorial symposium. (auth)

6643 SEASONAL MOVEMENT OF THE Sq CURRENT FOCI AND RELATED EFFECTS IN THE EQUATORIAL ELECTROJET. Tarpley, J. D. (National Oceanic and Atmospheric Administration, Boulder, CO). J. Atmos. Terrest. Phys.; 35: No. 6, 1063-1071(Jun 1973).

Geomagnetic observations from the western Pacific and Africa were used to determine the latitude of the focus of the Sq current system. The focus usually lies near 35°N over the western Pacific in February through July. During the autumnal equinox the northern focus shifts southward (equatorward) to around 27° latitude and then swings northward to 40 to 45°N in November and December. The movement of the southern hemisphere focus is complementary, that is, the equatorward shift occurs at the March equinox and the poleward movement during the June solstice. The seasonal movements of the Sq foci suggest an explanation for the semi-annual variation in the electrojet amplitude. The equatorward movement of one focus at each equinox will cause an equinoctial enhancement of the electrojet. The poleward shift of the northern focus in December and the southern focus in June account for the solstitial weakening of the electrojet. (auth)

6644 MOVEMENT OF IRREGULARITIES IN THE EQUATORIAL E-REGION. A Review. Kato, S. (Kyoto Univ.). J. Atmos. Terrest. Phys.; 35: No. 6, 1073-1082(Jun 1973).

There are various kinds of irregularities in the equatorial electrojet. Small irregularities consist of Type I and Type II. The Type I irregularities are produced by the two-stream instability and the Type II by the cross-field instability. Theory can explain the basic characteristics of these irregularities, but detailed agreement between theory and observation is still not confirmed. For large irregularities wind shear might be important. Observational checking is necessary. (auth)

6645 EQUATORIAL ELECTROJET. I. Development of a Model Including Winds and Instabilities. Richmond, A. D. (Air Force Cambridge Research Labs., L. G. Hanscom Field, MA). J. Atmos. Terrest. Phys.; 35: No. 6, 1083-1103(Jun 1973).

Physical features of the equatorial electrojet are examined in detail with the aid of a numerical model which includes neutral-air winds and the two-stream instability. It is found that the model currents and resultant magnetic variations are relatively unaffected by assuming the parallel conductivity, σ_0, to be infinite. This assumption permits a closed mathematical solution for the electric fields and currents. It also emphasizes that the electric field and current at a given point are strongly dependent on conditions along the entire magnetic field line, but are relatively independent of conditions along neighboring field lines. Height-varying east-west winds affect currents a few degrees off the dip equator more strongly than they do the equatorial currents. North–south winds cause currents to flow across the equator, but are relatively uninfluential on the eastward electrojet currents. The two-stream instability, as incorporated in the model, acts to limit the strength of the polarization electric field and the eastward current. Positive (negative) eastward gradients of the conductivities and of the electric field strength tend to decrease (increase) the electrojet current strength. Ionospheric distortion by the polarization electric field tends to decrease (increase) the currents when the eastward electric field tends to decrease (increase) the currents when the eastward electric field is positive (negative). Changes in a number of upper atmospheric parameters (temperature, electron density, magnetic field strength, charged particle collision frequencies) are tested in the model to illustrate how the currents are sensitive to the conductivity distributions. (auth)

6646 EQUATORIAL ELECTROJET. 2. Use of the Model to Study the Equatorial Ionosphere. Richmond, A. D. (Air Force Cambridge Research Labs., L. G. Hanscom Field, MA). J. Atmos. Terrest. Phys.; 35: No. 6, 1105-1118(Jun 1973).

Observations of the electrojet are examined in conjunction with a numerical physical model developed in a companion paper (Richmond, J. Atmos. Terr. Phys.; 35: 1083 (1973)). The model reproduces the basic features of the observed electrojet, but certain discrepancies suggest that the assumptions of the model or the conductivity distributions used may be inaccurate. Observations strongly indicate that height-varying winds similar in structure to the (1,1) tidal mode are present, and that the winds vary from day to day. Diurnal variations of the vertical electrodynamic plasma drift in the F region are deduced for different longitudes and for different seasons from magnetic data. The average quiet-day drift between 0700 and 1700 LT is upward, but the amplitude and form of the diurnal variation change significantly both with longitude and with season. (auth)

6647 COUNTER-ELECTROJET AND ESQ DISAPPEARANCE. Fambitakoye, O.; Rastogi, R. G.; Tabbagh, J.; Vila, P. J. Atmos. Terrest. Phys.; 35: No. 6, 1119-1126(Jun 1973).

The disappearance of Esq type traces from ionograms at the magnetic equator during magnetically quiet periods is related to inverted latitudinal profiles of the regular daily magnetic S_R variation (in its horizontal and vertical components). Latitude profiles obtained from a meridian chain of nine magnetometers across central Africa are compared with corresponding quarter-hourly ionogram sequences from Fort-Archambault-Sarh (Chad). Between 0900 and 1500 LT, the magnetic reversal coincides exactly with the disappearance of Esq traces. This evidence gives additional weight to the hypothesis of a counter-electrojet current belt, located on exactly the same latitudes as the normal electrojet and probably flowing below it at the bottom of the E layer. It agrees well with present theory on Type II slow turbulent modes, and confirms the $V_e \wedge B$ plasma instability mechanism as the cause of Esq inhomogeneities at this level. (auth)

6648 SEMI-ANNUAL VARIATION IN THE TRUE HEIGHT OF THE F2-PEAK IN LOW LATITUDES (AT PUERTO RICO). Yonezawa, T. (Radio Research Lab., Tokyo). J. Atmos. Terrest. Phys.; 35: No. 6, 1181-1186(Jun 1973).

Day-to-day values of true height of the F2-peak, h_mF2, at Puerto Rico have been subjected to a statistical analysis to reveal its semi-annual variation. The effects of solar rotation, solar activity, and geomagnetic activity have been subtracted from the values of h_mF2 over one year and the remainders have been subjected to harmonic analysis. The results for the six cases of combination of local times (noon and midnight) and years (1959 to 1961) show that the semi-annual variation in h_mF2 has an amplitude of the order of 10 km and reaches a maximum between the end of March and the beginning of May, the average date being April 25. This seems to suggest that the semi-annual variations in h_mF2 and in the peak electron density of the F2 layer are in phase, which is unfavorable to the supposition that the semi-annual variation in the F2 region is brought about by changes in atmospheric composition. (auth)

6649 RELATIONSHIP BETWEEN THE STRUCTURE OF THE EQUATORIAL ANOMALY AND THE STRENGTH OF THE EQUATORIAL ELECTROJET. Rush, C. M.; Richmond, A. D. (Air Force Cambridge Research Labs., L. G. Hanscom Field, MA). J. Atmos. Terrest. Phys.; 35: No. 6, 1171-1180(Jun 1973).

A detailed investigation of the relationship between the equatorial anomaly and the strength of the equatorial electrojet is made using data for all of 1958 in four longitude sectors. Correlation coefficients between hourly anomaly parameters and the midday electrojet strength tend to maximize for anomaly parameters between 1300 and 1600 LT. On a seasonal basis, the correlation coefficients tend to maximize when the subsolar point is between the geographic and magnetic equators, and to minimize around the June solstice. The correlations are significantly lower than those obtained by other researchers for solar minimum conditions. Close agreement between hour-to-hour changes in the electrojet strength and the time-rate-of-change of f_0F2 at the equator is observed during storm conditions. The results of this study are generally well explained by invoking the fountain theory for the formation of the anomaly. (auth)

6650 ROCKET MEASUREMENTS OF D-REGION ELECTRON DENSITIES AT THE EQUATOR. Somayajulu, Y. V.; Avadhanulu, M. B. Indian J. Radio Space Phys.; 1: No. 1, 81-83(1972).

D-region electron density profiles at the equator measured by rocket techniques are summarized. It is noted that these profiles are consistent with the current concepts of the ionizing sources and loss mechanisms which control the equilibrium electron densities in the D region. However, there appears to be some discrepancy regarding the cosmic-ray contribution, the actual values observed below 70 km being somewhat higher than the expected values. 20 ref. (ISA)

6651 SUMMARY AND FUTURE WORK. Cain, J. C. (Goddard Space Flight Center, Greenbelt, MD); Onwumechilli, A.; Mayaud, P. N.; Oni, E. J. Atmos. Terrest. Phys.; 35: No. 6, 1281-1282(Jun 1973).

The OGO-4 and -6 (POGO) magnetic field results for the equatorial electrojet indicate that while the present models are approximately correct, the possibility of a westward component must be incorporated. The scatter diagrams of the POGO amplitudes and surface data show a correlation. That is very good on the average but has numerous exceptions. The presence of the counter electrojet on occasion and the frequent deviations of the jet signature in ΔF from that predicted by a simple model implies that a fuller explanation is still lacking. This uncertainty is reinforced by the fact that the surface/satellite ratios are highly variable from time to time, whereas they should be definitely relatable. The state of research in this area has now reached a new level where the description and modelling can and must be worked out in terms of physical principles. A general plan to attack this subject is proposed. (UK)

6652 UNIFORM BELT OF DIFFUSE AURORAL EMISSION SEEN BY THE ISIS-2 SCANNING PHOTOMETER. Lui, A. T. Y.; Anger, C. D. (Calgary Univ., Alberta). Planet. Space Sci.; 21: No. 5, 799-809(May 1973).

One of the most striking and persistent features in high-latitude regions as seen by the ISIS-2 scanning auroral photometer is a fairly uniform belt of diffuse auroral emission extending along the auroral oval. Indications are that this region follows, contributes to, and may in a sense actually define the auroral oval during quiet times. The diffuse belt is sharply defined at its equatorward edge, which is located at an invariant latitude of about 65° in the midnight sector during relatively low magnetic activity (K_p = 1 to 3). The poleward edge of the region is not as sharply defined but is typically at about 68°. Discrete auroras (arcs and bands) are located, in general, near the poleward boundary of the diffuse aurora. The position of the belt appears to be relatively unaffected by the occurrence of individual substorms, even when discrete forms have moved well poleward. Representative intensities at 5577 Å are 102 kR (corrected for albedo) at quiet times and may reach 5 kR during an auroral substorm. It appears that the mantle aurora and proton aurora constitute this diffuse aurora in the midnight sector. Precipitating protons and electrons both contribute to the emissions in this region. (auth)

6653 OBSERVATION OF POLAR AURORA AND AIRGLOW FROM THE ISIS-2 SPACECRAFT. Shepherd, G. G. (York Univ., Toronto); Anger, C. D.; Brace, L. H.; Burrows, J. R.; Heikkila, W. J.; Hoffman, J.; Maier, E. J.; Whitteker, J. H. Planet. Space Sci.; 21: No. 5, 819-829(May 1973).

A preliminary but comprehensive report on coordinated data obtained with the ISIS-II spacecraft, fourth in the ISIS series, launched April 1, 1971, into a near circular 1400 km orbit is presented. The capabilities of the ISIS-I spacecraft have been extended in a number of ways, including the global mapping of the 3914, 5577, and 6300 Å emissions. Data obtained during a 30-min pass over the south pole depict the nightside oval and polar cap, as well as mid-latitude airglow effects; these data are described and discussed. (auth)

6654 TOTAL ELECTRON CONTENT OF THE EQUATORIAL IONOSPHERE. Rastogi, R. G.; Sharma, R. P.; Shodhan, V. (Physical Research Lab., Ahmedabad, India). Planet. Space Sci.; 21: No. 5, 713-720(May 1973).

Total electron content (N_t) variations in the ionosphere above the magnetic equator (Thumba dip 0.6°S) obtained by Faraday rotation measurements of beacon signals from S66 satellites are described for the period December 1965-August 1968. The N_t value reaches a minimum around 05 hr and a broad maximum between 14-18 hr, the diurnal ratio being more than 20. During no-echo condition at pre-sunrise hours, N_t is found to be abnormally low. The equivalent slab-thickness at Thumba is between 150 and 250 km except around 14 hr when it reaches a high value around 500 km. The electrons are almost equally distributed above and below the peak for the daytime hours, but in the latter part of the night the ratio of top-side to bottom-side electron content exceeds the value of 5. This high ratio is suggested as being due to a very low value of maximum electron density which during the pre-sunrise period becomes comparable to the electron density at great heights where there is no diurnal change of electron density. Combining the data of Thumba and Ahmedabad, the diurnal development of the equatorial anomaly in N_t is described. (auth)

6655 MILLSTONE HILL THOMSON SCATTER RESULTS FOR 1966 AND 1967. Evans, J. V. (Massachusetts Inst. of Tech., Lexington). Planet. Space Sci.; 21: No. 5, 763-792(May 1973).

Thomson (incoherent) scatter radar measurements of F-region electron densities and temperatures were made approximately twice per month throughout 1966 and 1967 at Millstone Hill for periods of 24 hr. Owing to the increase in sunspot activity the results display a rich variety of different types of behavior. Geomagnetically quiet days tended to follow patterns observed near sunspot minimum. Thus in winter there is typically a marked diurnal variation in electron density with a peak near noon and often a smaller secondary maximum between 02 and 04 EST. In summer there is less day-to-night variation and the peak density is encountered near ground sunset. Usually $h_{max}F2$ is higher in summer than winter and the layer thickness is larger also. Some magnetically disturbed days follow a distinct pattern in which N_{max} and h_{max} are normal during the first day of the storm until afternoon when they both increase to very high values. There is then a corresponding decrease in electron temperature. During the night the electron temperature often reaches abnormally high values, providing evidence of nocturnal heating. On the following day N_{max} and h_{max} are abnormally low. During 1967 instances in which the trough of low electron density moved south to occupy a position over Millstone became frequent. The electron temperature rose to particularly high values on these occasions. These morphological features are discussed in terms of current theoretical ideas. The results are also employed to derive seasonal variations of electron temperature and protonospheric heat flux. It is shown that since 1964 the protonospheric heat flux has been larger in winter than summer and displays a clear sunspot cycle variation. (auth)

6656 PARAMETRIC EXCITATION OF LANGMUIR OSCILLATIONS IN THE IONOSPHERE IN A STRONG RADIO WAVE FIELD. Vas'kov, V. V.; Gurevich, A. V. Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 2, 188-198(1973). (In Russian).

The conditions of excitation of the ionosphere parametric instability in the vicinity of the reflection point of an ordinary radiowave are considered. The increase of the radiowave field in the reflection region and its inhomogeneous structure are taken into account. Optimum conditions of the instability excitation are pointed out. (auth)

6657 DIFFUSION OF DENSITY AND TEMPERATURE PERTURBATIONS IN PLASMA IN THE MAGNETIC FIELD. Biragov, S. B. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 3, 358-362(1973). (In Russian).

Based on the set of quasi-hydrodynamic equations, the influence of the electron-temperature variations on the diffusion in the magnetoactive plasma is considered. Conditions are given which indicate when the temperature variations have a considerable effect on the diffusion. The fulfillment of these conditions in the ionosphere is discussed. (auth)

6658 INSTABILITIES IN CHARGE SHEETS AND CURRENT SHEETS AND THEIR POSSIBLE OCCURRENCE IN THE AURORA. Webster, H. F. (General Electric Co., Schenectady, NY); Hallinan, T. J. Radio Sci.; 8: No. 5, 475-482(May 1973).

An experimental demonstration has been given of the initiation of a vortex-forming instability in sheets of charge by perturbations in the shape of the sheet. The net motion of charge along the sheet wherever the sheet is bent is shown to be related to displacement of the potential minimum in the sheet. These results suggest the existence of an instability in current sheets which also produces vortex forms. There is evidence that both of these instabilities result in the formation of vortexes in the aurora. (auth)

6659 PATTERN RECOGNITION FOR VLF STUDIES. Jones, D. (European Space Research and Tech. Centre, Noordwijk, Netherlands). Radio Sci.; 8: No. 5, 467-473(May 1973).

The pattern-recognition technique described requires the simultaneous recording of a signal on two antennas, for example, orthogonal magnetic or electric sensors; after these signals are cross-correlated, a fast Fourier transform yields the complex cross-spectrogram. Provided that the polarization of the waves does not vary rapidly with time, it is possible to reject unwanted noise and to recognize the signal by utilizing the phase information in the cross-spectrum. This technique has been tested using computer-simulated signals, and it has been found that variable frequency signals, for example, whistlers, which are more than 12 db below an incoherent-noise background and more than 18 db below a coherent-noise background, are still recognized and are recorded to the exclusion of noise. The technique is applicable to plasma waves recorded on spacecraft as well as to electromagnetic waves. Although the polarizations of ground-recorded vlf signals are usually more complicated than those in the magnetosphere, the method is still relevant. (auth)

6660 MODELING THE D-REGION PARTIAL-REFLECTION EXPERIMENT. Cohen, D. J.; Ferraro, A. J. (Pennsylvania

State Univ., University Park). Radio Sci.; 8: No. 5, 459-465 (May 1973).

Recently published results on D-region partial-reflection amplitude distributions indicate that below 80 km, the distributions are Rayleigh-like in character. Because of this, a model of the partial-reflection mechanism is described which employs multiple reflectors as opposed to the single-reflector concept now in use by most experimenters using the partial-reflection experiment. The particular new feature incorporated by this model is the variation of the reflection coefficient throughout the reflecting volume; previous multiple-reflector models considered only the variation of the differential absorption in the reflecting volume. It is shown, for example, that for 50-μsec pulse lengths, serious errors in electron density can result in the analysis of partial-reflection data for which multiple reflectors are present. (auth)

6661 STATISTICAL MODELS FOR D-REGION PARTIAL-REFLECTION EXPERIMENTS. Shapiro, J. H. (Case Western Reserve Univ., Cleveland). Radio Sci.; 8: No. 5, 431-435(May 1973).

A phenomenological model for D-region partial-reflection experiments, which includes the effects of turbulent scattering, measurement noise, and coherent returns, is examined. General results for the amplitude and phase-difference statistics of the ordinary- and extraordinary-mode signals are obtained. These results are specialized and discussed for cases in which either the measurement noise or the coherent-signal component is insignificant. A possible criterion for discriminating between turbulence models and a single reflecting-layer model on the basis of amplitude statistics is obtained. (auth)

Magnetospheric Phenomena

Refer also to abstracts 6601, 6604, 7115, and 7157.

6662 (N-73-12388) PLASMA WAVE OBSERVATIONS NEAR THE PLASMAPAUSE WITH THE S3-A SATELLITE. Anderson, R. R.; Gurnett, D. A. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Jul 1972. Contract NAS5-11167. 27p. (NASA-CR-129243). NTIS.

The electric field noise phenomena is described which was observed by the S3-A spacecraft near the plasmapause during the magnetic storm of December 16 to 17, 1971. The occurrence is noted of a region of intense, low frequency (20 to 500 Hz) electrostatic noise bursts just outside the plasmapause boundary. These noise bursts occurred concurrent with the rapid decrease in $24.3 \le E \le 35.1$ keV ring-current protons mirroring near the equator during this storm and may be responsible for the pitch angle diffusion and loss of these particles. The characteristics of other phenomena, such as whistlers, elf hiss, and banded chorus, observed near the plasmapause during this period are also discussed. (STAR) (auth)

6663 (RLO-2229-T-5-3) STUDY OF MAGNETOSPHERIC SUBSTORMS IN CONJUNCTION WITH THE VELA SATELLITE DATA. Annual Progress Report. Akasofu, S. I. (Alaska Univ., College. Geophysical Inst.). Apr 1973. Contract AT(45-1)-2229. 6p. Dep. NTIS $3.00.

Progress is reported on a project to examine the complex behavior of the plasma sheet during magnetospheric substorms using Vela satellite data and simultaneous ground data, such as all-sky photographs and magnetic records. (WDM)

6664 COMPARISON OF GEOMAGNETIC CHANGES IN INDIA AND THE POGO DATA. Kane, R. P. (Physical Research Lab., Ahmedabad, India). J. Atmos. Terrest. Phys.; 35: No. 6, 1249-1252(Jun 1973).

Using the data obtained from POGO, the amplitude of the electrojet signature is compared with the daily variation amplitude of the quantity $(H_{TR}-H_{AL})$, i.e., the difference in the H values at the equatorial station Trivandrum (TR) and the low latitude station Alibag (AL). (auth)

6665 POGO DATA. Cain, J. C.; Sweeney, R. E. (Goddard Space Flight Center, Greenbelt, Md.). J. Atmos. Terrest. Phys.; 35: No. 6, 1231-1247(Jun 1973).

During intervals in 1967 to 1970, the OGO-4 and -6 spacecraft made over 2000 traversals over the equatorial electrojet in the altitude range 400 to 800 km when local times were between 9 and 15 h. These spacecraft carried total field magnetometers making measurements to an accuracy of 2γ with a sample rate greater than once a second. ΔF values, the deviations of these observations from an internal reference model, were plotted for a 30° band about the equator, and the characteristics of the electrojet effect in the data were investigated. This effect was characterized by a sharp negative V-signature of some 16° to 19° in width and a variable amplitude. The position of this minimum was found to lie within 0.5° of the dip equator. A slight northward shift was noted at the longitude of Huancayo. The jet amplitudes were normalized to 400 km amplitudes and observed to be highly variable in time. Amplitudes over the longitude range 50° to 90°W averaged 60% higher than elsewhere, as expected, due to the weaker main field. However, though the scatter of amplitudes is high, the expected minima in East Asia were not evident. It was speculated that this could be due to a less conducting upper mantle in this area. Numerous anomalous cases were observed, usually during magnetic disturbance. Although some of the largest eastward jets were observed at these times, there were also instances when the jet was absent or weakly westward. One such westward jet occurred during the recovery phase of a storm when there was no activity in the auroral zone. Other instances appeared where the V signature in ΔF spanning 20° in latitude became instead a triple V (VVV) covering about 40°. One interpretation would be the presence of an eastward current in the magnetosphere affecting the total field over about 20° of latitude in which the jet could be detected. The whole structure is imbedded in a reduced field of the characteristic DS shape. (auth)

6666 ULF GEOMAGNETIC VARIATIONS IN RELATION TO THE EQUATORIAL ELECTROJET. (Magnetic Field in Chad and Central Africa). Roquet, J. (Univ., Paris). J. Atmos. Terrest. Phys.; 35: No. 6, 1159-1170(Jun 1973). (In French).

With the purpose of studying their relationship with the equatorial electrojet, ulf geomagnetic variations of pc 3-4 and pi 1-2 were registered, from 1968 on until April 1970, in Chad and Central Africa. Simultaneous ulf registration sites included two fixed stations and two mobile ones, extended along a meridian profile crossing the electrojet zone from its southern to its northern edges. Banda, in the central zone, was selected as reference station, and a study was made of the behaviour of the ratio r of the amplitude of the magnetic pulsations at this station, to their amplitudes at the other stations. r differs little from unity for the central stations, with an exception for Kotongoro, attributable to local ground effect. For stations situated near the edges of the electrojet, a diurnal variation of r is strongly apparent and has been examined for each class of pulsations, with respect to the involved mechanisms of ionospheric transmission. (auth)

6667 ENERGY AND MOMENTUM THEOREMS IN MAGNETOSPHERIC PROCESSES. Carovillano, R. L. (Boston Coll., Chestnut Hill, MA); Siscoe, G. L. Rev. Geophys. Space Phys.; 11: No. 2, 289-353(May 1973).

This review deals with the several energy and momentum theorems that relate to magnetospheric processes that have been developed. The region of primary consideration is the magnetospheric domain that extends between the ionosphere and the interplanetary medium, although, for studying certain phenomena, ionospheric and solar wind properties are of central importance and must be included. Both energy theorems and momentum theorems with their applications are presented. Since energy is an integral property of the system variables, analytical results can be found without knowledge of detailed dynamical processes. Thus, relations are derived between particle and magnetic system energies, and application is made to the shape of the magnetopause and various phases of a magnetic storm. Particular attention is given to symmetric and asymmetric ring currents, including energy and momentum equilibrium conditions; a review of nonlinear self-consistent models and a discussion of how charge exchange and energy diffusion participate in the recovery phase are presented. Comprehensive expressions for the storm time disturbance field are given in terms of both ring current and boundary current energies, and changes that occur during magnetospheric compressions are discussed. The momentum theorems center around the requirement of static force balance during geomagnetically quiet intervals. Whereas the energy theorems give expressions for the average disturbance field over the Earth, the momentum theorems give the gradient in the disturbance field across the Earth. The forces between Earth and the boundary current, the ring current, and the tail current are derived for various models. It is noted that existing vacuum models of the geomagnetic tail are deficient in meeting the combined requirements of energetics and dynamics of the quiet time tail. Introducing the plasma sheet removes the difficulty by allowing an extra degree of freedom in adjusting the force between the Earth and the tail. The role of the plasma sheet in making force adjustments is shown to be consistent with the observed thinning of the plasma sheet before substorms. (auth)

6668 SEARCH FOR SPORADIC RADIO EMISSION FROM COSMIC SPACE AT CENTIMETER AND DECIMETER WAVELENGTHS. Tritskii, V. S.; Starodubtsev, A. M.; Bondar, L. N.; Zelinskaya, M. R.; Strezhneva, K. M.; Kitai, M. S.; Sergeeva,

A. I. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 3, 323-341(1973). (In Russian).

In the period of 1970–1971 a synchronous observation of radio bursts was made in the range of 3 to 50 cm at sites with different latitude and longitude (Murmanskaya region, Gorkovskaya region, Ussuriyskii kray, Crimea). It is shown that most of bursts observed at a given site is not the consequence of local radio noises but arise from the Earth's ionomagnetosphere as a result of excitation of oscillations by corpuscular fluxes associated with different phenomena of geomagnetic and solar activities. The global-type bursts occurring simultaneously at different points are discovered. The statistical characteristics of the bursts (distribution over duration, intensity, diurnal variation, etc.) are studied. It is shown that the mean burst duration varies in the limits of 0.5 to 4.5 min, depends mainly on the observation epoch but not on the wavelength and the observation point. (auth)

6669 QUASI-LINEAR INTERACTION OF WHISTLER-MODE WAVES AND NONTHERMAL ELECTRONS. Fung, P. C. W. (Stanford Univ., CA). Astrophys. Space Sci.; 16: No. 2, 249-273 (May 1972).

An attempt is made to analyze the quasi-linear cyclotron instability (under the weak turbulence regime) for whistler-mode waves due to pitch angle anisotropy of nonthermal electrons. The motivation of this study is to explain the triggered discrete vlf emissions occurring in the terrestrial magnetosphere. The time evolution of the growth rate and the induced waves spectrum for a loss cone type of nonthermal electrons is analyzed numerically. The diffusion of particles in pitch angles due to quasilinear cyclotron instability is illustrated. It is shown that several major features of triggered vlf emissions can be explained by the stated instability. Some predictions of the theory are given and suggestions for further research are presented. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstracts 5087, 6325, 6374, and 6706.

6670 (ORO–3557-14) PROTON SPUTTERING. Seventh Annual Progress Report, June 1, 1972–February 28, 1973. Finfgeld, C. R. (Roanoke Coll., Salem, VA. Dept. of Physics). 1973. Contract AT(40-1)-3557. 8p. Dep. NTIS $3.00.

Sputtering yields for H^+ and D^+ between 500 eV and 8 keV on tungsten, and D^+ ions on gold are given as a function of energy. (JFP)

6671 SOURCE OF ALKALI-METAL IONS. Avakov, A. S.; Belykh, S. F.; Evstifeev, V. V.; Evtukhov, R. N. (Tashkent State Univ.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 1002-1003(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 33-34(1972).

A simple construction of an alkali-metal ion source is proposed which allows an ion-current density of (1 to 2.5) 10^{-4} A/cm^2 to be obtained at accelerating voltages of 1 to 4.5 keV. (auth)

6672 THREE-BAND SELECTOR FOR DETERMINING THE VELOCITY DISTRIBUTION OF MOLECULES IN A MOLECULAR BEAM. Borovkov, I. S.; Pavlov, E. P. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1494-1496(1972).

Translated from Prib. Eksp.; 15: No. 5, 175-177(1972).

A method is proposed for determining the velocity distribution of molecules in a molecular beam, which is based on obtaining the approximate distribution functions corresponding to different selector passbands and on extrapolation of these functions to the function corresponding to the zero passband. A three-band mechanical velocity selector designed for the implementation of the method indicated is described. (auth)

6673 CHARACTERISTICS OF SECONDARY ELECTRONS KNOCKED OUT OF VARIOUS SUBSTANCES BY 412-keV γ RADIATION. Smirnov, V. V.; Malyshenkov, A. V.; Mushtatnyi, V. A. pp 161-165 of Prikladnaya Yadernaya Spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

6674 SECONDARY ELECTRONS EMITTED BY SUBSTANCES UNDER THE ACTION OF RADIATION FROM A ^{170}Tm SOURCE. Smirnov, V. V.; Malyshenkov, A. V. pp 166-169 of Prikladnaya Yadernaya Spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

6675 ANNIHILATION OF POSITRONS IN COPPER AND BRASS OF DIFFERENT THERMAL HISTORY. Vishnevskii, I. N.; Gavrilyuk, V. I.; Kupryashkin, V. T.; Latyshev, G. D.; Makovetskii, Yu. V.; Khalov, V. G. pp 262-269 of Prikladnaya Yadernaya Spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

6676 COMPARISON OF SOURCES OF BORON, PHOSPHORUS, AND ARSENIC IONS. Wilson, R. G.; Jamba, D. M. (Hughes Research Laboratories, Malibu, California 90265). Appl. Phys. Lett. 22: No. 4, 176-179 (15 Feb 1973).

A number of boron, phosphorus, and arsenic compounds, viz., B_2H_6, $B_{10}H_{14}$, $B_3N_3H_6$, B_2S_3, BF_3, BCl_3, BBr_3, BI_3, HBO_2, P, PH_3, PF_3, PF_5, PCl_3, $POCl_3$, P_2O_5, As, AsH_3, AsF_3, $AsCl_3$, and As_2O_5, are compared as sources of boron, phosphorus, and arsenic ion beams in a hot-filament electron-impact or oscillating-electron-discharge (OED) ion source. Performance comparison data, including the percentage of B^+, P^+, P^+_2, P^{+2}, As^+, As^+_2, and As^{+2} in the total beam and the maximum ion currents observed at the target of a 150-kV ion implantation system, are given for a common set of source and system conditions. BF_3 and BCl_3 are evaluated as the first and second best materials for B^+, with any other compound providing only a poor third choice. The pure elements P and As provide large currents of both monatomic and diatomic ions and have no other interfering ion components. PH_3 is a good source of P^+ but has strong nearby hydride ions. The fluorides of P and As provide good currents of monatomic ions and have proved convenient to use. (auth)

6677 USE OF COMPUTERS IN ELECTRON- AND ION-GUN DESIGN. Weber, C. (Philips Research Labs., Eindhoven, Netherlands). Comput. Phys. Commun.; 5: No. 1, 44-47(Jan 1973).

The influence of computers on gun design is explained with three examples, an ion gun characterized by negligible space charge, a C.R.T. gun characterized by the influence of space charge and initial thermal velocities, and a gun without rotational symmetry characterized by calculation in three dimensions. (auth)

6678 TRAPPING OF VERY LOW ENERGY ELECTRONS AND THE DEVELOPMENT OF A HIGH INTENSITY POLARIZED ELECTRON SOURCE. Brebec, J. M.; Coiffet, P.; Gilles, J. P. (Paris Univ., Orsay, France). Rev. Phys. Appl.; 7: No. 4, 339-351(Dec 1972). (In French).

The conditions necessary for trapping slow electrons in electromagnetic fields and transferring to them the polarization of an atomic beam, were studied. Two field configurations are proposed, from which a high intensity polarized beam can be obtained. The first solution is a classical configuration in which the injection system only has been modified; the second configuration uses an original magneto-electric system which should be able to give more than 1 mA peak current (more than 10^9 electrons per pulse) with a polarization of about 0.9. (FR)

Atomic and Molecular Properties

Refer also to abstract 6723.

6679 INFLUENCE OF COMPOSITION OF THE RARE EARTHS MIXTURE ON THE INTENSITY OF THEIR SPECTRAL LINES IN THE INDIRECT CURRENT ARC. I. Binary Mixtures of Yttrium, Lanthanum, and Light Lanthanons. Wysocka-Lisek, J. Ann. Univ. Mariae Curie-Sklodowska, Lublin Pol., Sect. AA; 26-27: 127-134 (1971). (In Polish).

The intensity of spectral lines of La, Y, Ce, Pr and Nd in their binary mixtures during indirect current arc excitation was investigated. The lowest intensity of spectral lines of Y, La, Pr and Nd was observed in their mixtures with cerium. Yttrium also reduced the intensity of spectral lines of the light rare earth elements. Neodymium and praseodymium as compared with lanthanum increased the intensity of spectral lines of the accompanying elements in the mixtures examined. (auth)

6680 INFLUENCE OF COMPOSITION OF THE RARE EARTHS MIXTURE ON THE INTENSITY OF THEIR SPECTRAL LINES IN THE INDIRECT CURRENT ARC. II. Binary Mixtures of Gadolinium with Y, Nd, Sm, La, Ce, Pr, and Er, and Binary Mixtures of Y, Nd, Sm, and Er. Wysocka-Lisek, J.; Glodo, K. Ann. Univ. Mariae Curie-Sklodowska, Lublin-Pol., Sect. AA; 26-27: 135-144 (1971). (In Polish).

The intensity of spectral lines of gadolinium in its binary mixtures with Y, Nd, Sm, La, Ce, Pr and Er was examined during intermittent, indirect current arc excitation. The intensity of gadolinium spectral lines varied in the mixtures and the minimum appeared in the Gd–Ce systems. The binary mixtures of Sm, Y, Nd, Gd and Er were investigated. The intensity of yttrium and neodymium spectral lines was almost the same in those different mixtures, only slightly changed with the increasing concentration of the accompanying elements. The intensity of samarium lines increased successively in its mixtures with Er, Y, Gd and Nd. The intensity of erbium spectral lines was the same in the Er–Y and Er–Sm systems; however, it increased in the Er–Gd and was the highest in Er–Nd mixtures. (auth)

6681 INFLUENCE OF COMPOSITION OF THE RARE EARTHS MIXTURE ON THE INTENSITY OF THEIR SPECTRAL LINES IN THE INDIRECT CURRENT ARC. III. Binary Mixtures of Y, La, Ce, Pr, Sm, Gd, and Er. Wysocka-Lisek, J. Ann. Univ. Mariae Curie-Sklodowska, Lublin-Pol., Sect. AA; 26-27: 145-150(1971). (In Polish).

The intensity of spectral lines of light lanthanons in their binary mixtures with yttrium, samarium, gadolinium and erbium during intermittent current arc excitation on the carbon electrodes is described. The intensity of lanthanum, cerium and praseodymium spectral lines was the highest in their mixtures with samarium; it decreased in their mixtures with erbium and was the lowest in the mixtures with yttrium and gadolinium. The highest decrease in the intensity of spectral lines of all the investigated elements was observed in their mixtures with cerium. (auth)

6682 INFLUENCE OF LANTHANUM AND CERIUM ON THE INTENSITY OF MANGANESE AND VANADIUM SPECTRAL LINES DURING INDIRECT CURRENT ARC EXCITATION. Wysocka-Lisek, J.; Martyniuk, M. Ann. Univ. Mariae Curie-Sklodowska, Lublin-Pol., Sect. AA; 26-27: 151-157(1971). (In Polish).

Investigations of the following systems: La–V, La–Mn, Ce–V, Ce–Mn, La–V–Mn, Ce–V–Mn, La–Ce–V, La–Ce–Mn and La–Ce–V–Mn were carried out during indirect current arc excitation. Different influence of the elements on the intensity of their spectral lines was observed in the investigated systems. The excitation on the copper electrodes caused an increase in the intensity of manganese spectral lines and a decrease in the intensity of cerium and lanthanum spectral lines. (auth)

6683 APPLICATION OF THE EXTENDED METHOD OF CALCULATION AND MANY-CONFIGURATION APPROXIMATION TO THE CONFIGURATION $3d^3$ OF Sc I AND V III. Stasyukaitis, V. Yu.; Kaminskas, V. A.; Jucys, A. P. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 12: No. 6, 903-909(1972). (In Russian).

The calculation of the energy spectra of the configuration $3d^3$ of Sc I and V III was improved, the completely filled inner shells being calculated by the ordinary method. To the 3d-electrons the extended method of calculation and the many-configuration approximation were applied separately as well as simultaneously. The energy spectra obtained are compared with the results of the ordinary method of calculation as well as with the experimental data available. (auth)

6684 MASS LEVELS OF THE HYDROGEN ATOM. Enatsu, H.; Kawaguchi, S. (Ritsumeikan Univ., Kyoto). Lett. Nuovo Cim.; 7: No. 1, 29-32(5 May 1973).

The results are presented of the calculation of the hyperfine mass levels of the hydrogen atom in the framework of a previously developed covariant Hamiltonian formalism. (LBS)

6685 EFFECT OF THE ORBIT–ORBIT INTERACTION IN THE CASE OF ENERGY SPECTRA OF RARE EARTH ATOMS HAVING THE ELECTRONIC CONFIGURATION $4f^N6s^2$. Vizbaraite, Ya. I.; Stasyukaitis, V. Yu.; Strotskite, T. D. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 12: No. 6, 921-925(1972). (In Russian).

The orbit–orbit interaction energy for the configuration $4f^N6s^2$ ($N = 2, 3, \ldots, 13$) of rare earth atoms is calculated. The values of the energy levels were obtained by diagonalizing the energy matrix calculated with the help of the solutions of conventional Hartree–Fock equations. The regularities of the contribution of the orbit–orbit interaction to energy spectra of the atoms under consideration are discussed. (auth)

6686 SOFT X-RAY ABSORPTION IN SOLIDS. Atomic or Band Approach: Which is Better? Kunz, C. Comments Solid State Phys.; 5: No. 2, 31-40(Jan 1973).

Recent work done in the soft x-ray region on solids, mainly metals, is discussed, including the question as to whether it would be possible to use available band structure calculations for the interpretation of absorption measurements in this energy range. Most of the success of the band structure picture in describing a crystalline solid is confined to a narrow environment of the Fermi level. Soft x-ray spectroscopy, however, allows study of electron transitions from deep-lying core levels into a wide range of conduction band states. Amongst matters discussed are: the one-electron picture; importance of atomic matrix elements; comparison between solid and gaseous states; excitons; "spikes" at the edge of absorption spectra; and importance of exchange interaction in rare earth and transition metals. The use of accelerated synchrotron radiation is stressed. (UK)

6687 PHASE MEASUREMENTS OF ZERO-FIELD OSCILLATIONS IN He I. Burns, D. J.; Hancock, W. H. (Univ. of Nebraska, Lincoln). J. Opt. Soc. Am.; 63: No. 2, 241-243(Feb 1973).

Zero-field oscillations in the decay of the $3p^3P \rightarrow 2s^3S$ 3889-Å radiation from He I following beam-foil excitation of singly ionized helium were observed. The initial phase of the oscillations was investigated, and the relative phase of the oscillations was measured. (CES)

6688 SPECTRUM AND ENERGY LEVELS OF DOUBLY IONIZED SCANDIUM (Sc III). Van Deurzen, Cornelius H. H. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720); Conway, John G.; Davis, Sumner P. J. Opt. Soc. Am. 63: No. 2, 158-163 (Feb 1973).

The spectrum of Sc III has been observed by using a vacuum sliding spark at 250–A peak current. Excellent separation of the Sc I, II, and III spectra was achieved by careful control of the excitation-circuit parameters. In all, 93 lines in the region 550–9400 Å are listed, which give rise to 23 new levels. The ionization energy of Sc III is revised to 199677.37 ± 0.1 cm^{-1}, based on the ng series, and series formulas are presented which were used to predict some of the newly found levels to within 0.25 cm^{-1}. An isoelectronic comparison of Sc III with K I and Ca II is made. (auth)

6689 ELECTRONIC EMISSION SPECTRA OF $H^{35}Cl^+$, $H^{37}Cl^+$, $D^{35}Cl^+$, AND $D^{37}Cl^+$. Sheasley, W. D. Columbus, OH; Ohio State Univ. (1972). 236p. University Microfilms Order No. 73-11,575. Thesis (Ph. D.).

A complete rotational analysis was performed which includes all of the observed bands in the electronic spectra of $H^{35}Cl^+$, $H^{37}Cl^+$, $D^{35}Cl^+$, and $D^{37}Cl^+$. The spectra were recorded in emission from an electrodeless discharge excited by microwave radiation at a resolving power of about 190,000. Previous observations were extended to include many additional bands involving higher vibrational levels in both the ground ($X^2\Pi_i$) and excited ($A^2\Sigma^+$) electronic states, leading to reliable estimates of equilibrium molecular constants. The present investigation also includes the first analysis of the system for the chlorine-37 isotope. Some of the equilibrium constants for $H^{35}Cl^+$, for example, were determined as follows: $\omega_e'' = 2673._7$ cm^{-1}, $\omega_e x_e'' = 52._8$ cm^{-1}, $B_e'' = 9.94_6$ cm^{-1}, $r_e'' = 1.315$ Å, $\omega_e' = 1606.4_7$ cm^{-1}, $\omega_e x_e' = 40.3_1$ cm^{-1}, $B_e' = 7.505_4$ cm^{-1}, and $r_e' = 1.514$ Å. The values of these constants cannot be as accurately determined as those for the individual vibrational levels (e.g., for $H^{35}Cl^+$, $B_0'' = 9.787\ 875(42)$ cm^{-1} and $B_0' = 7.341\ 577(93)$ cm^{-1}). This difference is a result of the limited number of vibrational levels observed for the ground state and the requirement of relatively high order fits to describe the vibrational dependence of molecular constants in the excited state. Potential energy curves were constructed for all four isotopic molecules using a Morse potential for the $^2\Pi$ state and an RKR potential for the $^2\Sigma^+$ state. A difference was observed between the calculated RKR potentials of the $^2\Sigma^+$ state for $H^{35}Cl^+$ and $D^{35}Cl^+$, thereby establishing the dissociation products of the $A^2\Sigma^+$ state as $H^+ + Cl(^2P)$. Franck–Condon factors were calculated for the A – X system of HCl^+ using Morse potentials to describe both electronic states. A comparison of calculated band intensities using these Franck–Condon factors with the experimentally observed intensities shows relatively good agreement for bands having the same value of v″ but poor agreement for bands having a constant v′. The conclusion reached is that there is apparently a change in the electronic transition moment with increasing v″. (JFP)

6690 FUNDAMENTAL AND FIRST OVERTONE BANDS IN THE RAMAN SPECTRA OF SOLID HYDROGEN AND DEUTERIUM. Prior, W. R. C. Toronto; Univ. of Toronto (1971). National Library of Canada, Ottawa.

Thesis (Ph. D.).

The Raman spectra of solid hydrogen and deuterium were studied using an argon laser for excitation. New information about the vibrational and rotational portions of the spectra was obtained, and the first overtone and several combination transitions were observed for the first time. The dependence of these lines on the concentration of the J = 1 species (1 to 99% of o-H_2, 5 to 95% of p-D_2) and temperature (1.3 and 4.3 K) was examined. (JFP)

6691 MAGNETIC PROPERTIES CALCULATION OF THE HYDROGEN MOLECULE BY THE VARIATION METHOD OF VECTOR POTENTIAL AND BY THE VARIATION METHOD OF INDUCED CURRENT. Kumanova, M.; Rebane, T. Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk.; 22: 27-34(1972). (In Russian).

The magnetic properties of hydrogen molecule are calculated by using a method of vector potential variation and a method of induced current variation, giving approximations to the precise value of calculated value from both sides. This permits one practically to exclude completely the error related to the using of perturbation method. Only the error due to approximation character of wave function is left. With atom wave function of type $\psi^{(0)}(r) = N(e^{-ar} a + e^{-ar} b)$, $a = 1.197$ by the method MO–LKAO with 4 parameters, when the magnetic field is perpendicular to molecule axe is given as an upper limit to the magnetic susceptibility the value $\chi_\perp \leqq -4.023 \times 10^{-6}$ cm^3/mol and as a lower limit– the value $\chi_\perp \geqq -4.123 \times 10^{-6}$ cm^3/mol. The current lines, calculated by both methods, are given. When the magnetic field is parallel to molecule axe, for the magnetic susceptibility $\chi_\parallel = -3.483 \times 10^{-6}$ cm^3/mol is given. For obtaining the best results, i.e. limited band, where the precise value is included it is necessary to select a sufficiently precise wave function. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

6692 RECENT PROGRESS IN MUONIC ATOMS. 4. Nuclear Polarization Effects. Wu, C. S. (Columbia Univ., New York); Wilets, L. Comments At. Mol. Phys.; 4: No. 1, 9-15(Jan 1973).

It is stated that the earliest discussion of nuclear polarization was that by electrons, due to Breit, Arfken and Clendenin (Phys. Rev. 78: 390(1950)). This was followed by calculations on muonic atoms by a number of authors, the most detailed being those of Chen (Phys. Rev. C1: 1167), Cole (Phys. Lett. B25: 178(1967) and Phys. Rev. 177: 164(1969)), and Skardhamar (Nucl. Phys. A 151: 154(1970)). The general approach to these calculations is given, although the various calculations differed in details of the nuclear models used and the self-consistency of the nuclear and muonic wave functions. The effect of polarization is to lower the energy of the ground state or the lowest state of a given symmetry. There is no direct experimental verification of nuclear polarization since each atomic transition measures a different moment of the nuclear charge distribution. The general approach is to measure precisely as many transitions as possible to and from the 1s, 2s, 2p, and 3d muonic levels, and from the measured transition energies make least-square fits to determine several parameters of the charge distribution and the nuclear polarization corrections. In addition to nuclear polarization due to electric multipole interaction, nuclear polarization due to magnetic interaction between the nucleus and the muon would be expected, and evidence for this has been found. (UK)

6693 RECENT PROGRESS IN MUONIC ATOMS. 3. Distribution of Nuclear Magnetism and Electric Quadrupole Moment. Wu, C. S. (Columbia Univ., New York); Wilets, L. Comments At. Mol. Phys.; 4: No. 1, 1-8(Jan 1973).

Nuclear magnetism is attributed to the orbital and spin motions of nucleons, and the distribution of this magnetism was utilized by Bohr and Weisskopf in a theoretical interpretation of the large observed hyperfine anomaly in the optical spectra of ^{85}Rb and ^{87}Rb. Calculation of the Bohr-Weisskopf effect for the muonic atom ^{209}Bi was first made with single particle and mixed configuration models due to LeBallac (Nucl. Phys. 40: 645(1963)). Johnson and Sorenson later introduced quadrupole models and extended the calculations to include a large group of nuclei. A study of the optical hyperfine spectra led to the discovery of nuclear M1 and E2 moments. For electronic atoms M1 and E2 atomic interaction energies are comparable, but in muonic atoms the M1 interaction is, in general, two orders of magnitude smaller than the E2 interaction, because the muonic magnetic moment is down by a factor 1/207. In muonic atoms, therefore, the M1 interaction is generally less than 1 or 2 keV, and in no case has the magnetic hyperfine structure been fully resolved. A discussion is presented on M1 and E2 interactions. (UK)

6694 π-MESOATOM ELECTROPRODUCTION. Dmitriev, V. F. (Inst. of Nuclear Physics, Novosibirsk, USSR). Yadern. Fiz.; 17: No. 4, 800-804(Apr 1973). (In Russian).

The π-meson electroproduction into bound states of a mesoatom is calculated. The background from two-nucleon splitting of the nucleus is estimated. It is shown that the ratio of the cross section of the effect to that of the background may be of the order of ~1 in the region of light nuclei. (auth)

6695 PHOTON-PLASMA TRANSITION $2^3S_1-1^3S_1$ IN POSITRONIUM. Kaplan, S. A.; Kleiman, E. B. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 1, 156-157(1973). (In Russian).

The probability of radiative transitions is generally larger than the probability of annihilation, but an orthopositronium atom possesses a metastable state $2^3\,S_1$. The probability of a two-photon radiative transition to the state $1^3\,S_1$ (1.8×10^{-3} sec^{-1}) and significantly smaller than a three-photon annihilation (8.9×10^5 sec^{-1}). The mathematical development shows that in a turbulent plasma medium a photon-plasma transition $2^3\,S_1-1^3\,S_1$ may be more effective than a three-photon annihilation. (KSW)

Collision Phenomena

Refer also to abstracts 6490 and 7013.

6696 (AERE-PR/NP-18, p 59) PRODUCTION OF K X RAYS BY 160-MeV PROTONS. Jarvis, O. N.; Whitehead, C.; Shah, M.; Sherwood, A. C. Mar 1972.

6697 (BNL-50336, pp 81-130) SECONDARY ELECTRON EMISSION. Dettmann, K. (Kernforschungsanlage, Juelich, Ger.). Feb 1973.

In interaction of energetic charged particles with solids.

The theory of inelastic atomic collisions is formulated and applied to secondary electron emission in ion, particularly proton, reactions with solids. Only kinetic ejection is studied. (JFP)

6698 (BNL-50336, pp 150-185) INTERATOMIC POTENTIALS FOR ATOMIC-COLLISION STUDIES. Torrens, I. M. (CEN, Saclay, France). Feb 1973.

In interaction of energetic charged particles with solids.

The review is restricted to the interaction between atoms at distances less than the equilibrium separation in the solid, which is the range which is important for atomic collisions and radiation damage studies. The many-body problem, the Thomas-Fermi statistical model, screened Coulomb potentials and pair interactions, the Born-Mayer potential, the potential in the intermediate energy range, interatomic potentials and atomic collision theory, basic features and problems of scattering experiments, and interatomic potentials derived from planar channeling data are covered. (JFP)

6699 (ORO-3027-22) EXCITATION AND IONIZATION OF IONS BY ELECTRON IMPACT. Technical Progress Report, September 1, 1972-May 31, 1973. Feeney, R. K.; Devine, T. F.; Hooper, J. W.; McPherson, D.; Sayle, W. E. (Georgia Inst. of Tech., Atlanta. School of Electrical Engineering). 31 May 1973. Contract AT(40-1)-3027. 17p. Dep. NTIS $3.00.

Research on the excitation and ionization of ions by electron impact is summarized. A list of publications is included. (JFP)

6700 He_2^+ AND Ne_2^+ ION DISSOCIATION IN THE REGION OF KINETIC ENERGIES UP TO 100 eV. Zhurkin, E. S.; Tikhomirov, M. V.; Tunitskii, N. N. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 208: No. 5, 1097-1099(11 Feb 1973). (In Russian).

The transverse cross sections of dissociation of He_2^+ and Ne_2^+ were measured in the kinetic energy region of 100 eV for the following processes: $He_2^+ + He \rightarrow He^+ + 2\,He$, $Ne_2^+ + Ne \rightarrow Ne^+ + 2\,He$. The investigation was conducted with the aid of a double mass spectrometer arrangement. The cross section of dissociation of He_2^+ decreased at energies <40 eV; that of Ne_2^+ decreased at energies <28 eV. These phenomena are discussed. (KSW)

6701 STARK BROADENING OF PASCHEN LINES IN A DEUTERIUM DISCHARGE. Himmel, G.; Pinnekamp, F. (Univ., Bochum, Ger.). J. Quant. Spectrosc. Radiative Transfer; 13: No. 6, 555-566(Jun 1973).

The Paschen lines P_8 to P_{13} emitted from a radio-frequency discharge ($N_e = 2.2 \times 10^{13}$ cm^{-3}) have been measured photoelectrically. The experimental profiles are compared with refined quasistatic calculations. These calculations include Doppler and apparatus broadening. It is shown that the quasistatic theory applied here provides a useful description of the line wings, as well as of the region around the halfwidth. Only at the line core must a contribution from electron collisional broadening be assumed to smooth structures retained in the quasistatic calculations. This contribution is small; its magnitude is estimated to be of the order of Griem's term (Astrophys. J.; 136: 422 (1962); 147: 1092 (1967)) accounting for strong collisions. (auth)

6702 RESONANT CHARGE EXCHANGE BETWEEN DIPOLE MOLECULES. Vitlina, R. Z. (Inst. of Semiconductor Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 64: No. 3, 796-799 (Mar 1973). (In Russian).

Charge exchange between a dipole molecule and its ion is considered. It is shown that the presence of a dipole moment in the molecule violates the resonant character of the process and considerably alters the charge exchange cross section. (auth)

6703 DETERMINATION OF POLARIZATION DEGREE OF COHERENT BREMSSTRAHLUNG FROM DIAMOND MONOCRYSTAL. Gorbenko, V. G.; Derkach, L. M.; Zhebrovskii, Yu. V.; Kolesnikov, L. Ya.; Rubashkin, A. L. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 17: No. 4, 793-799(Apr 1973). (In Russian).

The simple formula is obtained relating the minimal value of the γ-quanta polarization degree with the value of the coherent effect and relative energy of photons in the process of a bremsstrahlung relativistic electron on a monocrystallic radiator. The effect of experimental parameters, i.e., the electron beam divergence, multiple scattering in the target, the energy resolution of detecting apparatus and of the background radiation on the γ-quanta polarization degree in the interference maximum from an isolated node (2,0) of inverse lattice of the diamond monocrystal is discussed. It is shown that the relation of the maximal value of the photon polarization degree with the value of the coherent effect is independent of the type of monocrystal and of initial energy of electrons. (auth)

6704 ENERGY DISTRIBUTION OF ELECTRONS EMITTED BY ARGON ATOMS UNDER ELECTRON IMPACT. Ogurtsov, G. N. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz.; 64: No. 4, 1149-1153(Apr 1973). (In Russian).

The absolute values of the differential cross sections for electron emission in collisions between fast electrons and argon atoms are measured by means of a cylindrical electrostatic mirror. The measurements are performed for incident electron energies of 50 to 2000 eV and an electron emission angle of 54.5°. Data on the total cross sections for excitation of the argon L shell by electron impact are presented which are obtained by integrating the structure corresponding to Auger transitions over the emitted electron energy and solid angle. (auth)

6705 DETECTION OF RADIATION THAT ACCOMPANIES ELECTRON ION COLLISIONS IN INTERSECTING BEAMS. Dashchenko, A. I.; Stakhno, E. P.; Imre, A. I. (Uzhgorod State Univ., USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1203-1204(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 196-198(1972).

A system is described for recording weak light radiation in the investigation of the excitation of ions by electron impact using double modulation of beams which allows measurement of the useful signal for a signal-to-background ratio down to 1/100. (auth)

6706 DECAY OF 2S STATES OF THE HYDROGEN ATOM IN A MAGNETIC FIELD. Gurevich, A. I. (Moscow Engineering Physics Inst.). Zh. Eksp. Teor. Fiz.; 64: No. 4, 1199-1210 (Apr 1973). (In Russian).

The 2S−2P transitions in hydrogen atoms located in a magnetic field induced by collisions with the ions are considered. The cross section of the process and the probability for decay of the 2S-state due to motion of the atoms in a magnetic field are calculated. It is shown that both the cross section and probability for four values of magnetic field strength corresponding to intersection of the hydrogen atom term with a principal quantum number $n = 2$ possess sharp peaks. This phenomenon may be employed for obtaining polarized beams of hydrogen atoms in the 2S-state. (auth)

6707 SOME IONIZATION PROPERTIES OF A SUBSTANCE BOMBARDED BY AN INTENSE ELECTRON BEAM. Smiyan, O. D.; Kruzhkov, A. G.; Tovmachenko, V. N.; Kolomiychuk, B. N. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 17: No. 7, 1149-1153(Jul 1972).

Translated from Radiotekh. Elektron.; 17: No. 7, 1465-1470 (Jul 1972).

The intersection of a beam of high energy electrons (30 to 70 keV) with a solid target is considered. The conditions for the appearance and the factors influencing the observed high voltage electron-ion emission are described. The possibility of the practical use of this phenomenon is noted. (auth)

6708 STUDY OF THE BETHE SURFACES OF H_2, He, Ne, AND Ar, INCLUDING COMPTON PROFILES, DIFFERENTIAL CROSS SECTIONS AND CHEMICAL BINDING EFFECTS (IN H_2) USING keV INCIDENT ELECTRONS. Ulsh, R. C. Bloomington, IN; Indiana Univ. (1972). 123p. University Microfilm Order No. 73-9782.

Thesis (Ph. D.).

The Compton profile of H_2 was calculated, with and without a vibrational effect included, using a Wang wave function. It was found that the anharmonicity of the H_2 potential energy curve caused a 1% increase in J(q) at low electron momentum. Measurements of the energy loss spectrum using keV electrons scattered from H_2, He, Ne, and Ar at large scattering angles which define a portion of the Bethe surface are reported. The results are in good agreement with the theory of the Compton effect where the incident x-ray is replaced by a high energy electron. The angular dependence of the inelastic scattering is found to be in agreement with the first Born approximation including interference and exchange effects assuming weakly bound target electrons. The ratio of the inelastic peak height to the elastic peak height and the results of the binary encounter theory are found to be in agreement within experimental uncertainties. The electron impact spectra for He and H_2 have been obtained at the scattering angles 1, 1.5, 2, 3, 4, 5, 7, and 10° using 25-keV incident electrons. The measured intensity values were converted to generalized oscillator strengths and placed on an absolute scale by the use of the Bethe sum rule for the generalized oscillator strength distribution at each separate scattering angle. Both elastic and total inelastic differential cross sections were extracted from the measured double differential cross sections by correcting for relativistic and exchange effects and integrating over energy loss. The results are in excellent agreement with rigorous theoretical calculations. The He double differential cross sections were also compared with the predictions of the binary encounter and first Born theories. Substantial deviations were found between binary encounter theory and experiment for momentum transfer values below 3 a.u. but only in the regions removed from the maximum of the spectral distribution. It was definitely established that the deviations were due to the failure of the binary encounter theory. Compton profiles were found to be in excellent agreement with previous electron impact, and x-ray measurements. The auto ionizing double excitations (2s2), $2p^2$ etc.) in He were observed at both 1° and 2.7°. The results were partially analyzed by use of the Fano line shape theory. The $2^1P \leftarrow 1^1S$ transition was also a prominent feature of the Bethe surface. The qualitative angular dependence of the transition suggested a possible large angle deviation from the first Born theory. Chemical binding effects in H_2 were explored; for the first time various binding energies were determined separately from the elastic, inelastic and total differential cross sections. Certain optical sums (2,1,-1,-2) for the generalized oscillator strength were also obtained. The consistency of the data and agreement with available theory strongly argue that, with the possible exception of the large angle bound state excitation contributions to the spectrum, the first Born scattering theory is obeyed at all angles and energy losses studied within an average accuracy of about 2 to 10%. (Diss. Abstr. Int., B)

6709 SURFACE AND VACUUM PHYSICS INDEX. Volume 8, No. 3, 1973. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 72p.

6710 SECHENIYA VOZBUZHDENIYA ATOMOV I IONOV ELEKTRONAMI. (Electron Excitation Cross Sections of Atoms and Ions). Vainshtein, L. A.; Sobel'man, I. I.; Yukov, E. A. Moscow; Izdatel'stvo nauka Glavnaya Redaktsiya Fiziko-Matematicheskoi Literatury (1973). 144p.

Approximation methods are given for the calculation of effective cross sections and probabilities of various atomic processes: excitation and ionization of atoms and ions by electron bombardment, the probabilities of radiation-induced transitions in discrete spectra and photo recombinations. About 80 pages of graphs and tables are presented which facilitate the calculation of cross sections for various types of transitions, probabilities and rates of atomic processes, etc. (24 references) (KSW)

6711 POLARIZATION POTENTIAL FOR ELASTIC SCATTERING OF SLOW POSITRONS BY HYDROGEN ATOMS. Nakazaki, S. (Miyazaki Univ., Japan). Miyazaki Daigaku Kogakubu Kenkyu Hokoku; No. 18, 111-116(Aug 1972). (In Japanese).

The polarization potential for elastic scattering of slow positrons from hydrogen atoms is determined in the adiabatic approximation using a new function that includes effective charge for hydrogen atom. The function is determined by a simple variational calculation, minimizing the energy of disturbed atom. This approach is more general than perturbation theory and a calculation of Stone. Using this polarization potential, the zero-order positron-hydrogen phase shifts and scattering length are calculated for the various approximations. The best value obtained for scattering length is $-1.58a_0$ and may be compared with the results of Stone, Hashino and Nakazaki, Schwartz and Rotenberg. (auth)

6712 EFFECT OF HIGHER-ORDER POLARIZATIONS ON THE ELASTIC SCATTERING OF SLOW POSITRONS BY HELIUM ATOMS. Hashino, T.; Nakazaki, S. (Miyazaki Univ., Japan). Miyazaki Daigaku Kogakubu Kenkyu Hokoku; No. 18, 73-77(Aug 1972). (In Japanese).

Scattering length and cross sections are calculated for elastic collision of slow positrons by helium atoms considering some of the higher order of polarization potentials given by Temkin theory. It is found that the values of the scattering length and cross section depend for the most part on the lower order polarization, but higher order polarization cannot be neglected. The best value obtained for scattering length is $-0.457\ a_0$ and may be compared with the value $-0.398\ a_0$ calculated by Houston and Moiseiwitsch using Kohn's variational method together with trial function employing 21 linear parameters and three exponential parameters, the value $-0.575\ a_0$ calculated by Kestner et al. using a pseudopotential and the value $-0.546\ a_0$ given by Hashino previously. (auth)

Atomic Theory

6713 HYDROGEN-LIKE ATOM IN A SUPER-STRONG MAGNETIC FIELD. Krainov, V. P. (Moscow Engineering-Physics Inst.). Zh. Eksp. Teor. Fiz.; 64: No. 3, 800-803(Mar 1973). (In Russian).

The problem of terms of a hydrogen-like atom in a superstrong magnetic field is solved. Conditions are found for which the ground term approaches the lower boundary of the Dirac continuum. (auth)

6714 INVESTIGATION OF THE ATOMIC ELECTRON CONFIGURATION $1s^22s^22p^N3d$ BY THE EXTENDED METHOD OF CALCULATION. Zhvirblis, P. S.; Nashlenas, E. P.; Jucys, A. P. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 12: No. 6, 911-920(1972). (In Russian).

The extended method of calculation was applied to the atoms and single-valued positive ions having electronic configurations $1s^22s^22p^N3d$ ($N = 0, 1, \ldots, 6$). The analytical radial orbitals were used. Their parameters were estimated from the minima of the lowest energy level of the configuration under consideration. The nonrelativistic energies as well as the absorption oscillator strength and the spontaneous emission probabilities for the transitions $1s^22s^22p^N - 1s^22s^22p^{N-1}3d$ were calculated and tabulated. (auth)

6715 ORBIT–ORBIT INTERACTION IN MANY-ELECTRON ATOMS. Saxena, K. M. S.; Fraga, S. (Univ. of Alberta, Edmonton). Liet. Fiz. Rinkinys; 12: No. 6, 927-930(1972).

The formulation for the evaluation of the complete orbit–orbit interaction between closed shells is examined. The expressions of the matrix elements, up to f electrons, are given in terms of radial integrals. (auth)

6716 DYNAMIC STRUCTURAL CORRECTIONS FOR MAGNETIC INTERNAL CONVERSION COEFFICIENTS OF THE M-SHELL OF AN ATOM. Shulyakovskii, G. S.; Trusov, V. F.; Borisoglebskii, L. A. (Belorussian State Univ., Minsk). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 136-138(1972). (In Russian).

The dynamic structural corrections for internal conversion coefficients are examined, as based on the hypothesis of surface currents of the transition. These corrections are fairly small (1 to 8%), and are generally within the limits of experimental error. Equations were derived from the general expression for magnetic internal conversion coefficients and used to compute normalization factors for the M_{III}-subshell when $L = 2$, $K = 0.1$, and $Z = 65$ and 94. (KSW)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

6717 MHD FLOW ALONG AN INFINITE FLAT WALL WITH CONSTANT SUCTION. Rao, V. V. R.; Sithapathi, A. (Andhra Univ., Waltair, India). Proc. Indian Acad. Sci., Sect. A; 77: No. 1, 42-50(Jan 1973).

Exact solutions of the Navier–Stokes equations are derived by a Laplace-transform technique for two-dimensional, incompressible flow of an electrically conducting fluid past an infinite porous plate under the action of a transverse magnetic field subject to the conditions: the magnetic Prandtl number P_m is unity, and the Alfven velocity is less than the suction velocity. It is assumed that the flow is independent of the distance parallel to the plate and that the velocity component normal to the plate is constant. General formulas are derived for the velocity distribution and the magnetic field in terms of the given external velocity. The skin-friction is obtained and some special cases are considered. (auth)

6718 RELATIVISTIC FLUID DYNAMICS. Conference Held at Bressanone, Italy, June 7–16, 1970. Rome; Edizioni Cremonese (1971). 424p. (In English and French). (CONF-700677–).

From symposium on relativistic fluid dynamics; Bressanone, Italy (7 Jun 1970).

The conference included six papers. Separate abstracts were prepared for two papers. Other papers on hydrodynamics, kinetic theory of gases, and relativistic propagation of heat were outside the scope of NSA. (JFP)

For abstracts of individual papers see: 6719 and 7253.

6719 SHOCK WAVES, INFINITESIMAL WAVES, AND RAYS IN RELATIVISTIC HYDRODYNAMICS AND MAGNETOHYDRODYNAMICS. Lichnerowicz, A. pp 87-203 of Relativistic Fluid Dynamics. Rome; Edizioni Cremonese (1971). (In French)

From symposium on relativistic fluid dynamics; Bressanone, Italy (7 Jun 1970). See CONF-700677-.

Detailed study of infinitesimal waves and shock waves in magnetohydrodynamics, using a relativistic extension of Weil's compressibility conditions in developing the theory. A convenient mathematical apparatus (tensor distributions) is systematically introduced through the analysis of the different waves. This apparatus is applied first in hydrodynamics, to the study of sound waves and the corresponding rays. Turning to magnetohydrodynamics, a study is then made of the basic system of differential equations, the structure of magnetosonic waves and Alfvén waves, the corresponding rays, and shock waves, which are analyzed in detail. In particular, an important existence and uniqueness theorem is established for the nontrivial solutions of the shock equations by the introduction of a convenient Hugoniot function. In treating magnetosonic waves by the shock wave formalism, the noninvariance of the direction of the rays is demonstrated by the infinitesimal discontinuity operator. (ABK)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 6529 and 6534.

6720 (CERN/ECFA-72/4(Vol.2), pp 1-27) INTRODUCTION. Jan 1973.

In ECFA: 300 GeV Working Group.

The research program at CERN is summarized. Also machine construction schedules for the 300-GeV program are discussed. (JFP)

Electromagnetic

Refer also to abstracts 6523 and 6675.

6721 STUDY OF ELECTROPRODUCTION WITH A STREAMER CHAMBER FOR $0.3 < Q^2 < 1.5$ (GeV)^2, $1.3 < W < 2.8$ GeV. Eckardt, V. (Deutsches Elektronen-Synchrotron, Hamburg); Gebauer, H. J.; Joos, P.; Meyer, H.; Naroska, B.; Notz, D.; Podolsky, W. J.; Wolf, G.; Yellin, S.; Dau, H.; Drews, G.; Greubel, D.; Meincke, W.; Nagel, H.; Rabe, E. Lett. Nuovo Cim.; 6: No. 14, 551-556(7 Apr 1973).

Results are reported from an experiment designed to observe all charged hadronic final-state particles produced in ep interactions in the transition region between photoproduction and the scaling domain. Results are given on the charged multiplicities and the π^- inclusive spectra. (LBS)

6722 HADRON PAIR PRODUCTION BY ELECTRON-POSITRON COLLIDING BEAMS. Barbiellini, G. (CNEN, Frascati, Italy); Grilli, M.; Iarocci, E.; Spillantini, P.; Valente, V.; Visentin, R.; Ceradini, F.; Conversi, M.; d'Angelo, S.; Giannoli, G.; Paoluzi, L.; Santonico, R.; Nigro, M.; Trasatti, L.; Zorn, G. T. Lett. Nuovo Cim.; 6: No. 14, 557-565(7 Apr 1973).

Measurements of the total cross section for the reaction $e^+e^- \rightarrow h^+h^-$ ($h = \pi$ or K) at 1.2 to 2.4 GeV are reported from a colliding beam experiment using two spark chamber-counter telescopes. Information is obtained on the pion electromagnetic form factor squared as a function of the four momentum squared for different fits of the experimental data assuming different values of the ratio $\sigma_{KK}/\sigma_{\pi\pi}$. (LBS)

6723 PRECISION MEASUREMENT OF THE MAGNETIC MOMENT OF THE PROTON IN NUCLEAR MAGNETONS AND THE MASS DIFFERENCE OF THE DOUBLET $H_2^+-D^+$. Luxon, J. L. Jr. Ann Arbor, MI; Univ. of Michigan (1972). 212p. University Microfilms Order No. 73-11,192.

Thesis (Ph. D.).

The results of the application of a new technique for observing ion cyclotron resonance to the measurement of the magnetic moment of the proton in nuclear magnetons μ_p/μ_n and the mass difference of the $H_2^+-D^+$ doublet are reported. This technique combines the methods of the Michigan g-factor group for the trapping of charged particles in a shallow magnetic mirror well with an RF cyclotron resonance process. The magnetic moment of the proton in nuclear magnetons is given by $\mu_p/\mu_n = \omega_s/\omega_0$, where $\omega_0 = \gamma\omega_c = eB/M_pc$ is the zero energy cyclotron frequency of a proton with mass M_p in a magnetic field B, and ω_s is the spin flip frequency. The time-average value of the cyclotron frequency is determined from the RF resonance lineshape, and the time-average spin frequency is obtained by averaging the results of an NMR map over the axial and cyclotron motions of the ions in the well. The preliminary results of our work with the apparatus are: $\mu_p'/\mu_n = 2.792\ 786 \pm 0.000\ 017$ (6.0 ppM) for protons in a spherical water sample, and $H_2^+-D^+ = 1548.22 \pm 0.20\ \mu$u. These results are in agreement with the more accurate work of others. (Diss. Abstr. Int., B)

6724 MEASUREMENT OF THE Σ^+ MAGNETIC MOMENT. Saha, M. Pittsburgh; Carnegie-Mellon Univ. (1972). 105p. University Microfilms Order No. 73-4379.

Thesis (Ph. D.).

Approximately 370,000 pictures exposed to the 40" Michigan propane bubble chamber at the ZGS of the Argonne National Laboratory were analyzed for Σ^+'s produced by the reaction $K^-P \rightarrow \Sigma^+\pi^-$ with K^- momentum ranging from 250 to 550 MeV/c. A 45 kG magnetic field applied perpendicular to the incident beam precessed the Σ^+-spin through a 9° angle (on the average) before the Σ^+ decayed into the final state $p\pi^0$. The final sample after various cuts consists of 2880 events with average time of flight of 1.5×10^{-10} seconds and average polarization of 0.37. A maximum likelihood analysis yields $2.63\,^{+.81}_{-.81}$ nuclear magnetons for the Σ^+ magnetic moment. (Diss. Abstr. Int., B)

6725 MEASUREMENT OF MAGNETIC BREMSSTRAHLUNG SPECTRUM AND PAIR PRODUCTION CROSS SECTIONS. Mashkour, M. Chicago; Illinois Inst. of Tech. (1972). 177p. University Microfilms Order No. 73-12,220.

Thesis (Ph. D.).

In the following the characteristic features of the synchrotron radiation (magnetic bremsstrahlung) which is emitted when electrons with energies of 20 GeV are incident on magnetic fields with intensities of 1 to 2 MG are examined. Under these circumstances the bremsstrahlung photon energy range is three orders of magnitude beyond all preceding experiments. Although the principal features of the radiation can still be computed according to the methods of classical electrodynamics, the radiation reaction force has become an appreciable fraction of the external Lorentz force. Also some properties of the electron-positron pair production, in the energy range 10 to 300 MeV, which were determined as a byproduct of the use of the emulsion technique are described. These properties are: The distribution of the divergence angle between the electron and positron, their energy partition, and the distribution of the recoil momenta and the angular distribution of the nuclei in whose Coulomb fields the pair production took place. Furthermore, the effect of the photon polarization on the pair production was studied. These results represent a significant extension of previously available work on pair production. In general, good agreement with the theoretical predictions was observed. (JFP)

6726 PROPERTIES OF SYNCHROTRON RADIATION AND ITS APPLICATION. Sokolov, A. A.; Ternov, I. M.; Korolev, F. A.; Mikhailin, V. V.; Khalilov, V. R. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 7-13(1972). (In Russian).

A brief review is given of the properties and uses of ultrarelativistic electrons moving in a curved trajectory with a macroscopic radius. The history of synchrotron radiation, its sources, its employment in physics and technology, and its role in special fields of physics are discussed. (Four references.) (KSW)

Weak

Refer also to abstract 6522.

6727 (COO-881-380) SEARCH FOR THE RARE DECAY, $K^+ \rightarrow \pi^+e^-$. Clarke, D. B. (Wisconsin Univ., Madison). 1973. 101p. Dep. NTIS $7.25.

Thesis.

The results of a search for $K^+ \rightarrow \pi^+e^+e^-$ decays are presented. A large magnetic spectrometer using sparkostrictive wire chambers detected K^+ decays in a 1.475 GeV/c kaon beam at the Bevatron. Lepton pairs were identified by two large atmospheric pressure-Freon Čerenkov counters. Analysis programs identified events with three tracks or with two tracks which formed an e^+e^- pair. Analysis of the three track events yields the branching ratio limit, $\Gamma(K^+ \rightarrow \pi^+e^+e^-)/\Gamma(K^+ \rightarrow \text{all}) < 1.53 \times 10^{-6}$ (90% confidence). The two track events are analyzed by searching for sparks on a possible pion track. The resulting limit, $\Gamma(K^+ \rightarrow \pi^+e^+e^-)/\Gamma(K^+ \rightarrow \pi^+e^+e^-) < 2.6 \times 10^{-7}$ (90% confidence), is lower than for three tracks because of increased triggering and program efficiencies. In the analysis, the invariant mass region, $Me^+e^- \leq 50$ MeV/c, is excluded to remove most of the background from Dalitz decays of a π^0 from other kaon decays. The Dalitz decays with $Me^+e^- > 50$ MeV/c, principally from $K_{\pi 2}$ decays, provide a calibration for the efficiency of the system. (auth)

6728 MEASUREMENT OF THE K_1 BRANCHING RATIO INTO TWO PIONS. Cowell, P. L. Stony Brook, NY; State Univ. of New York (1972). 125p. University Microfilms Order No. 73-10,890.

Thesis (Ph. D.).

A spark chamber experiment to measure the branching ratio of the short-lived K_1 meson into the modes $\pi^+\pi^-$ and $\pi^0\pi^0$ was performed at the Princeton-Pennsylvania Accelerator. A 1.0 GeV/c beam of incident π^- mesons produced Λ^0K^0 from a polyethylene target. The decay of Λ into π^-p was used as a signal for the associated production of a K^0. It was assumed that half of the K^0's decayed as K_1 and half decayed as K_2, a result of CPT invariance. The trigger consisted of an anti-counter behind the target, to indicate neutral particle production, and a 10×10 hodoscope of crossed one-inch wide scintillator strips set to trigger on a particle producing three times minimum ionization, to detect the proton from the decay $\Lambda - \rightarrow \pi^-p$. A total of 160,000 pictures taken in two views was completely scanned for vees and all tracks were measured. The neutral decay mode of the K_1 into $\pi^0\pi^0$ was not detected. The trigger arrangement rejected 40% of the K_1 charged decays ($K_1 - \rightarrow \pi^+\pi^-$) and this bias was corrected by a Monte Carlo calculation. Distributions from the Monte Carlo were compared with those from the data to obtain an accurate estimate of the losses. All K_1 charged decays which did not anti were detected, even when one track left too few sparks in the chamber to be measured, by including single tracks among the sample of K_1 charged decays if the track originated from the vicinity of the target. The largest background arising from the "one-track" K^0 decays, coming from K_2 charged decays, was 2% of the branching fraction and easily eliminated. The film was partially scanned by physicists for single-track K_1 charged decays, and the results were projected onto the unscanned portion of the film using the measured data as a base. A final sample of 16,000 K_1 charged decays and 65,000 Λ charged decays directly determined the branching fraction for K_1 to decay into $\pi^+\pi^-$ to be 0.684 ± 0.01. The branching ratio found by this experiment is then $\Gamma(K_1 - \rightarrow \pi^+\pi^-)/\Gamma(K_1 - \rightarrow \pi^0\pi^0) = 2.17 \pm 0.10$. (Diss. Abstr. Int., B)

Strong (Baryon-induced)

Refer also to abstract 6939.

6729 ANTINEUTRON ANNIHILATION. Deka, G. C.; Laskar, I. (Cotton Coll., Gauhati, India). J. Assam Sci. Soc.; 12: 119-124(1969).

During a systematic search for charge-exchange reactions of antiprotons ($\bar{p}$) in G5 emulsions which were exposed to a beam of 3 GeV/c $\bar{p}$ obtained from the CERN P.S., a pair of closed stars was found. Detailed analysis showed that the first star having $N_h = 15$ and $n_s = 1$ was produced in the probable reaction $\bar{p} + p \rightarrow \bar{n} + p + \pi^-$, whereas the second star having $N_h = 21$ and $n_s = 3$ was determined to be the result of annihilation of the antineutron ($\bar{n}$) in the probable reaction $\bar{n} + n \rightarrow \pi^+ + \ldots$ This is an illustrative event in support of the charge exchange of 3 GeV/c antiprotons. (auth)

6730 AVERAGE MULTIPLICITY OF PARTICLES IN THE QUARK MODEL. Anisovich, V. V.; Kobrinskii, M. N.; Likhoded, A. K.; Shekhter, V. M. (Inst. of Nuclear Physics, Leningrad). Yadern. Fiz.; 17: No. 3, 662-664(Mar 1973). (In Russian).

Further experimental evidence in favor of the quark model was sought, beginning with an examination of hadron (h) formation in nucleon–nucleon and meson–nucleon encounters: $N + N \rightarrow h + X$, and $M + N \rightarrow h + X$. Experiments were conducted with the hydrogen chamber "Mirabel" at the Serpukhov accelerator to measure the multiplicity of the charged particles. From the point of view of the quark model at high energies, the average of the multiplicity and the topological cross section in antiproton–proton and proton–proton collisions should be identical, but at Serpukhov energies the total cross section for $\bar{p}p$—is significantly greater than that for pp-encounters. (KSW)

6731 SEVERAL CHARACTERISTICS OF THE DISINTEGRATION OF PHOTOEMULSION NUCLEI INDUCED BY 70-GeV/c PROTONS. Deka, G. C.; Pathak, K.; Sarma, H. K. (Gauhati Univ., India). Yadern. Fiz.; 17: No. 3, 660-661(Mar 1973). (In Russian).

Previous workers had investigated the angular distributions of shower and "grey" particles and the correlations between the number of shower and strongly ionized particles. The present authors conducted analogous investigations at high energies with cameras loaded with emulsions of different thicknesses (400 and 600 μ), studying interactions with heavy particles in the emulsion where $N_h \geq 7$. A graph of n_s vs N_h yielded straight lines which had a positive slope for protons of various energies, but a negative slope for 5 GeV antiprotons. (KSW)

6732 PROTON–PROTON INELASTIC SCATTERING AT VERY HIGH ENERGIES. Babcock, B. A. Ann Arbor, MI; Univ. of Michigan (1972). 135p. University Microfilms Order No. 73-11,034.

Thesis (Ph. D.).

The differential inelastic cross section $Ed^3\sigma/dP^3$ for particles produced in very high energy proton–proton collisions at the CERN Intersecting Storage Rings were measured. Inclusive reactions of the type $p + p \rightarrow x +$ anything, where x could be a pion, kaon, or proton were studied. The momenta of the two colliding beams varied from 15.3 to 26.5 GeV/c. This was equivalent to laboratory beams of 500 to 1500 GeV/c hitting stationary targets. The dependence of these inclusive cross sections on the transverse and longitudinal momenta of the outgoing particle $P_\perp$ and $P_{||}$ respectively was examined. The spectrometer consisted of three magnets, five scintillation counters, and two gas threshold Cherenkov counters. The first two magnets served to steer particles with the desired values of $P_\perp$ and $P_{||}$ down the axis of the spectrometer. The third magnet deflected the particles vertically for momentum analysis. The fivefold coincidence of the scintillation counters indicated the passage of a particle through the spectrometer. The Cherenkov counters then enabled us to identify it as a pion, kaon, or proton. It was found that when the cross section $Ed^3\sigma/dP^3$ was plotted as a function of X, the pion and proton data were consistent both in shape and normalization with data taken at lower accelerator energies. This therefore appears to support a type of scaling. The variable X is related to the longitudinal momentum of the outgoing particle by $X = P_{||}/P_{max}$, where P_{max} is the maximum possible value $P_{||}$ may have. At small X, the pion cross section is either slightly increasing or flat. There is a slight decrease in the proton cross section at small X. When plotted as a function of $P_\perp^2$, the pion and proton cross sections again seem to have the same slope as data taken at lower energies; $\sim \exp(-4.0P_\perp^2)$. There is a distinct forward peak of the form $\exp(-10P_\perp^2)$ in the pion cross section which is absent in the proton data. The scarcity of K^+ events only permits one to state that the K^+/π^+ ratio is of the order of 10%. (Diss. Abstr. Int., B)

6733 REGGEIZED DECK MODEL ANALYSIS OF SOME ELEMENTARY PARTICLE PRODUCTION PROCESSES. Schnitzler, D. T. Detroit; Wayne State Univ. (1972). 154p. University Microfilms Order No. 73-12,593.

Thesis (Ph. D.).

Elementary particle production processes of the type $A + B \rightarrow C + D + E$ are investigated. A theoretical model, called the Reggeized Deck model, was successful in describing the process $\pi p \rightarrow \pi\rho p$. Its ability to describe the experimental data for the processes $pp \rightarrow pp\omega$, $\pi p \rightarrow K^*Kp$, and $pp \rightarrow p\pi\Delta$ is tested. The process $pp \rightarrow pp\omega$ is analyzed in terms of the Reggeized Deck model. Diagrams with π-ρ, π-B, ω-pom, and p-pom exchange are found to be important contributors. Extensive use is made of experimental data on the two-body processes $\pi N \rightarrow \omega N$, $pp \rightarrow pp$, and $\gamma p \rightarrow \omega p$. Vector dominance is used to obtain $\omega p \rightarrow \omega p$ from $\gamma p \rightarrow \omega p$. The large amount of experimental data, including the prominent peak in the total cross section, is well accounted for. It is pointed out that interference effects cannot be neglected on phase space arguments alone, and may be important in this process. The F_1 (1540) enhancement was observed in the process $\pi p \rightarrow K^*Kp$ and also in $p\bar{p} \rightarrow K^*K\pi$. It is shown that in $\pi p \rightarrow K^*Kp$ it can be explained, via the Reggeized Deck model, as kinematic enhancement. In $p\bar{p} \rightarrow K^*K\pi$ it is most easily explained as a resonance. An estimate of the expected $\rho\pi$ and $\omega\pi$ decay modes of the F_1 indicates that its G-parity cannot be determined, in the usual way, by observing these decays. The Reggeized Deck model is shown to describe, simultaneously, the two processes $pp \rightarrow p\pi^+\Delta^0$ and $pp \rightarrow p\pi^-\Delta^{++}$, without relying on adjustable parameters. (Diss. Abstr. Int., B)

6734 THREE BODY REACTIONS FROM $\bar{p}n$ INTERACTIONS AT 3.5 GeV/c. Schneider, F. L. Athens, OH; Ohio Univ. (1972). 148p. University Microfilms Order No. 73-12,648.

Thesis (Ph. D.)

The investigator presents the results of an experimental analysis of the reaction $\bar{p}n \rightarrow \bar{p}p\pi^-$ (1) using film obtained from an exposure of the 30″ deuterium-filled bubble chamber at the Argonne National Laboratory to a separated beam of 3.5 GeV/c antiprotons. The results presented are based upon about 92,000 pictures. The data are explicitly compared with two versions of the one-pion-exchange (OPE) model in order to determine the production mechanism for reaction (1). The reaction is dominated by the production of the $\overline{\Delta}^{2-}$(1236) antiisobar in predominately peripheral interactions. The total cross section for reaction (1) based upon a deuterium density of .139 g/cm³, is $\sigma = (2.91 \pm 0.17)$ mb. The fitted rest mass of the $\overline{\Delta}^{2-}$, width of the $\overline{\Delta}^{2-}$, and percent $\overline{\Delta}^{2-}$ are (1224.2 ± 1.5) MeV/c², (95.4 ± 4.8) MeV/c², and (82.0 ± 1.7)%, respectively. The S-P-wave interference model is not able to account for the large asymmetry present in the Jackson angle of the decaying $\bar{p}\pi^-$ system. This asymmetry is not due to experimental biases, dynamical interference, interference with overlapping resonance bands, or interference with background systems. The absorption model in its present form and the OPE model with or without form factors predict no asymmetry whatever in the Jackson angle of the decaying $\bar{p}\pi^-$ system. The pure P-wave model density matrix elements are consistent with OPE as a production mechanism for the $\overline{\Delta}^{2-}$ excepting ρ_{33}. As the four momentum transfer, t, from the $\bar{p}$ to the $\bar{p}\pi^-$ approaches 0.0, ρ_{33} approaches ≈ 0.1. This result implies that strong absorptive effects are present (as expected because of the annihilation channels available) and/or the exchange of particles with spin is taking place. The sharp decline of the t distribution and the isotropy of the Trieman-Yang distribution are both consistent with OPE as a production mechanism. (Diss. Abstr. Int., B)

6735 PROTON–ANTIPROTON ELASTIC SCATTERING AT 2.32 GeV/c. Allison, W. W. M. (Nuclear Physics Lab., Oxford); Jones, A. Q.; Fields, T.; Cooper, W. A.; Rhines, D. S. Nucl. Phys.; B56: No. 1, 1-14(1973).

New $\bar{p}-p$ elastic-scattering data from a hydrogen bubble chamber experiment at 2.32 GeV/c are presented. A total sample of 79,149 events gives accurate data in the range $\cos\theta_{cm} = -0.98$ to $+0.972$. Sources of systematic loss are examined and corrected for. Limits are put on the real parts of the forward scattering amplitudes, on the difference between singlet and triplet total cross sections, and on the cross section for excitation of s-channel resonances giving rise to backward peaks. (auth)

Strong (Meson-induced)

6736 (COO-1428-319) PARTIAL-WAVE ANALYSIS OF THE LOW MASS $(\pi^+\pi^+\pi^-)$ SYSTEM PRODUCED BY INCIDENT π^+ MESONS AT 13 GeV/c. Thompson, G.; Gaidos, J. A.; McIlwain, R. L.; Willmann, R. B. (Purdue Univ., Lafayette, Ind.). 24 Jan 1973. Contract AT(11-1)-1428. 30p. Dep. NTIS $3.50.

Results are presented of a spin-parity analysis of the $(\pi^+\pi^+\pi^-)$ system formed opposite the proton, neutron, and deuteron by incident 13-GeV/c π^+ mesons in a bubble chamber exposure of 750,000 pictures. Relative proportions of the contributing J^P states are given for $(3\pi)^+$ masses between 0.9 and 1.4 GeV/c^2 and their dependence on $t'_{\pi\to3\pi}$ is also discussed. Measurement of the phase between interfering production amplitudes gives information about the resonance status of the A_1, and A_2 mesons. The method employs the University of Illinois three body partial wave analysis program. (auth)

6737 (ORO-2504-206) DIFFERENTIAL CROSS SECTIONS FOR ELASTIC π^+P SCATTERING BETWEEN 1.2 AND 2.3 GeV/c. Technical Report No. 73-104. Abe, K.; Barnett, B. A.; Goldman, J. H.; Laasanen, A. T.; Steinberg, P. H. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Apr 1973. 55p. Dep. NTIS $4.75.

The π^+P differential cross sections were measured at sixteen momenta between 1.2 and 2.3 GeV/c. Typically 50,000 elastic events were obtained at each momentum in the center of mass angular region $0.9 > \cos\theta > -0.9$. The experiment was performed at the Zero Gradient Synchrotron at Argonne National Laboratory using a two stage enriched pion beam. The apparatus consisted of a liquid hydrogen target surrounded by two banks of wire spark chambers with magnetostrictive readouts. Two Cerenkov counters were used to identify beam pions and the scattering events were analyzed by an on-line computer. The data are presented in the form of angular distributions and also in terms of Legendre polynomial expansion coefficients. Total elastic cross sections and zero degree forward differential cross sections are obtained. The data are compared with existing phase shift analyses. Dips in the cross sections are observed at $t \cong -0.6$ and at $u \cong 0$ and -1.1. Results of an attenuation study to determine the muon content of the beam are presented. The pion mean free path in iron is found to be substantially larger than that obtained from the geometric cross section. (auth)

6738 DEFINITION OF EFFECTIVE NUCLEON NUMBER IN CARBON AND XENON NUCLEI IN STUDYING πN INTERACTIONS. Vorob'ev, I. I.; Veselovskii, G. S.; Novikov, L. S.; Shishov, N. N. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 17: No. 3, 551-554(Mar 1973). (In Russian).

Effective numbers of nucleons-targets in carbon and xenon nuclei for 0-, 1-, 2-, 3-, and 4-prong stars in π-meson interaction with nucleon of nuclei were determined at the momenta about 3 GeV/c. It has been established, that the mean number of effective protons for 0-, 2-, and 4-prong events is 2.4 ± 0.3 and 5.1 ± 0.3 respectively, and the mean number of effective neutrons for 1- and 3-prong events is 1.8 ± 0.3 and 5.5 ± 0.3. (auth)

6739 PRODUCTION OF f^0-MESON IN $\pi^-p \rightarrow p\pi^+\pi^-\pi^-$ REACTION AT MOMENTUM 4.5 GeV/c. Kliger, G. K.; Kolganov, V. Z.; Smolyankin, V. T.; Nilov, A. F. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 17: No. 3, 555-560(Mar 1973). (In Russian).

The production cross section for f^0-meson in $\pi^-p \rightarrow p\pi^+\pi^-\pi^-$ reaction was studied at average momentum 4.5 GeV/c (7056 events) with the help of 55- and 50-cm liquid hydrogen bubble chamber. The following values of the production cross section for f^0-meson in different channels were determined: $\sigma_{tot}(f^0) = 88 \pm 8$ μbn, including $\sigma(\pi^-p \rightarrow N^{*0}_{1236}\, f^0) = 16.5 \pm 5$ μbn, and $\sigma(\pi^-p \rightarrow pA_3^- \rightarrow p\pi^-f^0) = 47 \pm 7$ μbn. The total cross section for A_3 meson production is found to be equal to $\sigma(\pi^-p \rightarrow pA_3^{\pm}) = 64 \pm 7$ μbn. (auth)

6740 B(1235) AND RHO(1710) PRODUCTION ON NUCLEI. Arnold, R.; Engel, J. P.; Escoubes, B.; Kurtz, N.; Lloret, A.; Paty, M.; Riester, J. L.; De Unamuno, S. (Univ., Strasbourg). Lett. Nuovo Cim.; 6: No. 17, 707-714(28 Apr 1973).

In a heavy-liquid bubble-chamber search for coherent production processes on nuclei induced by 11.7-GeV/c incident π^+, leading to all possible pionic channels, a sample of π^+ + nucleus $\rightarrow$ $\pi^+ + \pi^+ + \pi^- + \pi^0$ + nucleus events was obtained, which provides information on the B(1235) and δ(1710) meson resonances. These particles are shown to be produced via incoherent reactions, and the results for cross sections and decay properties are compared with similar production on free protons. (LBS)

6741 TESTS ON HELICITY CONSERVATION IN INTERACTIONS π^+p AT 11.7 GeV/c AND π^-p at 11.2 GeV/c. Evans, D. (Univ. of Durham, Eng.); Contri, R.; Teodoro, D.; Tomasini, G.; Sahini, M.; Schilling, P.; Cantore, A.; Liotta, L.; Chaumet, M.; Daronian, P.; Faccini, M.; Lewin, C.; Mosca, L. Nuovo Cim.; 14A: No. 4, 651-666(21 Apr 1973).

Various diffractionlike reactions, selected from 11.7 GeV/c π^+p and 11.2 GeV/c π^-p interactions in the 1.5 m BNHBC and 2 m CERN-HBC are tested for s- and t-channel helicity conservation. From a detailed analysis of azimuthal distributions, no evidence is found either for s- or t-channel helicity conservation. (auth)

6742 ELASTIC πN-SCATTERING AND BACKWARD CHARGE EXCHANGE WITH THE ACCOUNT OF CUT CONTRIBUTION. Boreskov, K. G.; Ter-Martirosyan, K. A.; Tsukerman, I. S. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 17: No. 4, 846-851(Apr 1973). (In Russian).

The experimental data on elastic $\pi^{\pm}p$-scattering and π^-p-charge exchange in the energy range higher than ~6 GeV are described in the framework of the complex momentum theory with the account of the cut contribution. (auth)

6743 BACKWARD ρ^--MESON PRODUCTION IN REACTION $\pi^-p \rightarrow p\rho^-$ WITHIN THE INCIDENT MOMENTUM INTERVAL 1.80 TO 3.25 GeV/c. Vladimirskii, V. V.; Dzhelyadin, R. I.; Dukhovskoi, I. A.; Kishkurno, V. V.; Krutenkova, A. P.; Kulikov, V. V.; Radkevich, I. A.; Fedorets, V. S. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 17: No. 4, 788-792(Apr 1973). (In Russian).

The differential cross section of the backward $\rho^{\pm}$-meson production in reaction $\pi^-p \rightarrow p\rho^-$ at nine incident π^--meson momenta within the interval 1.8 to 3.25 GeV/c is studied using a magnetic spectrometer with spark chambers. (auth)

6744 COHERENT π^0-PHOTOPRODUCTION ON DEUTERIUM IN THE FIRST RESONANCE REGION. von Holtey, G. (European Organization for Nuclear Research, Geneva); Knop, G.; Stein, H.; Stuempfig, J.; Wahlen, H. Z. Phys.; 259: No. 1, 51-59(1973).

Differential cross sections for coherent π^0-photoproduction from deuterium were measured in the photon energy range from 240 to 400 MeV and for pion c.m. angles between 70° and 160°. The recoil deuterons were analysed in angle and momentum by a magnetic spectrometer. The cross sections obtained were higher by a factor of about 2 compared with the results from Stanford, the only data available up to now in the first resonance region. Below the resonance the measured cross sections give a smooth extension to the low energy data from Glasgow and Orsay. (orig) (GE)

6745 $\bar{K}N$ DATA AND Λ(1405). Chao, Y. A. (Rutherford High Energy Lab., Chilton, Eng.); Kraemer, R. W.; Thomas, D. W.; Martin, B. R. Nucl. Phys.; B56: No. 1, 46-51(1973).

A re-analysis of low-energy $\bar{K}N$ data was made to investigate the effects of imposing constraints below the elastic threshold. The results show that without below-threshold constraints little information about the parameters of the Λ(1405) can be determined. (auth)

6746 STRANGE PARTICLE PRODUCTION FROM π^-p INTERACTIONS AT 1.69 GeV/c. Thomas, D. W.; Engler, A.; Fisk, H. E.; Kraemer, R. W. (Carnegie-Mellon Univ., Pittsburgh). Nucl. Phys.; B56: No. 1, 15-45(1973).

The three-body final states $\Sigma^{\pm}\pi^{\mp}K^0$, $\Sigma^{\overset{-}{0}}\pi^{\overset{0}{-}}K^+$ and $\Lambda\pi^{\overset{-}{0}}K^{\overset{+}{0}}$ produced from πp interactions at 1.69 GeV/c are examined. The quasi-two-body state $\Lambda(1405)K^0$ is discussed in detail. In particular, the spin of Λ(1405) is determined, via the method of Byers and Fenster, to be consistent with ½. The $\Sigma^{\pm}\pi^{\mp}$ mass spectrum is compared to that produced by various zero-range and effective-range parametrizations and the Λ(1405) is found to have a mass of 1405 MeV and width of 45–55 MeV. Production and decay characteristics of the quasi-two-body states $\Sigma(1385)^{\overset{-}{0}}K^{\overset{+}{0}}$ are reported. (auth)

Particle Interactions and Properties (Theoretical)

General

6747 PROPERTIES OF PARTICLE–ANTIPARTICLE PROCESSES WITH DIFFERENT ENERGY BEHAVIOR. Mickens, R. E.

(Fisk Univ., Nashville). Lett. Nuovo Cim.; 6: No. 17, 692-694 (28 Apr 1973).

Models where the Pomeranchuk singularity makes different contributions to the particle–particle and particle–antiparticle amplitudes are considered. The consequences of analyticity in energy and crossing for scattering amplitudes that have different energy dependences for particle–particle and particle–antiparticle processes are discussed. (LBS)

6748 ASYMPTOTIC BEHAVIOR OF ELASTIC FORM FACTORS AND THE LIGHT-CONE. Vinciarelli, P.; Weisz, P. (Univ. of Maryland, College Park). Lett. Nuovo Cim.; 6: No. 15, 624-626(14 Apr 1973).

The relation that exists among the requirements of compositeness, of locality, and the nature of inelastic processes is used to study the asymptotic behavior of elastic form factors in the theoretical framework of light-cone expansion. In particular, an attempt is made to link such asymptotic behavior to integral conditions (sum rules) satisfied by the one-particle forward matrix elements of bilocal operators which appear in the light-cone expansion for the product of two currents. (LBS)

6749 LIGHT-CONE COMMUTATORS AND BILOCAL OPERATORS. Jackiw, R. (Massachusetts Inst. of Tech., Cambridge). Comments Nucl. Particle Phys.; 5: No. 5, 153-160 (1972).

Reference is made to Gell-Mann's equal-time algebra of currents, and recent research in field theory is summarized that has extended equal-time current algebra to the "light-cone". The principal achievement is a derivation of a plausible expression for the "light-cone" commutator. An important application is concerned with deep inelastic processes, such as the MIT-SLAC inelastic electron scattering experiment at high energies. A further application is concerned with the derivation of fixed mass sum rules. Both of these applications together with others, are discussed. Among other matters discussed is how the "light-cone" current commutator can be determined without solving any dynamical equations. It was by no means anticipated that the formulae for "light-cone" commutators would be as simple as they have turned out to be. Especially remarkable is the lack of dependence on the nature of interactions; the free-field "light-cone" commutators coincide with the interacting field commutators, in complete analogy with the equal-time case, and furthermore the new operators that occur, the bilocal currents, are simple generalizations of the ordinary familiar currents, the difference being that the fields occurring in the bilocal current are separated, although the separation is zero in the covariant sense. The simplicity and elegance of the results suggest their abstraction from the wide class of quark models and the postulation of their validity in nature. Bilocal currents are operators whose matrix elements give deep inelastic form factors, just as local currents have matrix elements that give elastic form factors. Bilocal operators occurring in current commutators are measurable objects with direct physical significance and their algebraic structure can be used to derive sum rules for the structure functions. It is concluded that much useful theory will emerge once the properties of bilocal currents are fully understood. (UK)

6750 LANDOLT-BOERNSTEIN. Numerical Data and Functional Relationships in Science and Technology. New Series. Group I. Nuclear and Particle Physics. Volume 6. Properties and Production Spectra of Elementary Particles. Diddens, A. N.; Pilkuhn, H.; Schluepmann, K. Berlin; Springer-Verlag (1972). 173p. (In German and English).

A compilation of basic particle properties, form factors, and coupling constants is given. The relations between experimentally measured quantities and fundamental properties of interactions is explained. Data on scattering processes and the spectra of particles produced in p-p interactions are also included. (CES)

6751 HIGH-ENERGY RELATIONS FOR SCATTERING OF PARTICLES AND ANTIPARTICLES HAVING GIVEN PROPERTIES UNDER CROSSING. Mickens, R. E. (Fisk Univ., Nashville). Lett. Nuovo Cim.; 6: No. 16, 655-658(21 Apr 1973).

It is shown that by making specific assumptions about the asymptotic crossing properties of the scattering amplitude, more possibilities occur for relationships among the physical observables of particle and antiparticle reactions as compared to amplitudes with generalized power behavior. Pomeranchuk theorems for the differential and integrated cross sections are obtained for two cases. (LBS)

6752 PADE APPROXIMANTS IN QUANTUM FIELD THEORY. Bessis, D. (Univ. of Western Ontario, London). pp 275-298 of Padé Approximants and Their Applications. Graves-Morris, P. R. (ed.). London; Academic Press Inc. (London) Ltd. (1973).

From conference on Padé approximants; Canterbury, UK (17 Jul 1972). See CONF-720612–.

The nature of the problems of the equations for field theory is stated, and the reasons for introducing Padé approximations, including the analytic properties of the solution in the coupling strength, and the variational properties of the approximations. Sections cover: the example of quantum electrodynamics—the theory of photons and electrons; the case of the strong interaction physics—interactions between pions and nucleons, and the choice of the type of interaction Lagrangian; the diverging nature of the solution and the problems of its analytical continuation; the construction of the S-matrix expansion, the unitarity of the S matrix, the Hermitean part of T_n and the renormalization; properties of the S-matrix Padé solution, the unitarity and analyticity properties, the mass spectra, the variational principles of Kohn and Lippmann-Schwinger, practical convergence, models for which the convergence is proven rigorously; the strong interaction between pions and nucleons and the search for a Lagrangian. (UK)

6753 MODEL FIELD THEORIES AND PADE APPROXIMANTS. Pusterla, M. (Univ., Padua). pp 299-311 of Padé Approximants and Their Applications. Graves-Morris, P. R. (ed.). London; Academic Press Inc. (London) Ltd. (1973).

From conference on Padé approximants; Canterbury, UK (17 Jul 1972). See CONF-720612–.

It is stated that Padé approximants, once their convergence is under control, are very useful in the inspection of the physical content of models of field theory. Two reasons are given for analysing model field theories: (a) the possibility of seeing in detail whether local renormalisable models admit solutions; (b) the kind of physics that can be developed from local Wick polynomials, chosen as interaction terms. It is stated that the importance of (a) and (b) justifies the treatment of Lagrangians consisting of local fields with the addition of the typical features of the physical particles being considered, namely the spin, the isospin, etc. Detailed discussion covers: pion–pion interaction models; the Yang-Mills field; pion-nucleon interactions; calculations for phase shift of S waves and P waves and D waves, and comparison with experimental data; nucleon-nucleon interaction—the Yukawa interaction. (UK)

6754 PARALLEL PLANES IN SPACE–TIME AND POSSIBLE ORIGIN OF PARTICLES. Oektem, F. (Middle East Technical Univ., Ankara). Nuovo Cim., 15A: No. 2, 189-208(21 May 1973).

The fields of parallel planes in space–time and their physical interpretations are investigated. Canonical forms are given for the metric of space–time admitting of a field of parallel planes, and for the normal bases of parallel planes. A hypothesis is advanced which associates with every particle a field of parallel planes in space–time. Some of the results obtained from this hypothesis are: there exist in Nature at most five classes of particles, if each is described by space–time with a definite field of parallel planes; the recurrence vector of a parallel null 1-plane represents the electromagnetic potential so that no electromagnetic field can be present in flat space–time; more generally, the recurrence vectors of a parallel m-plane are interpreted as the potentials of a gauge field that obeys the generalized Maxwell's equations. (auth)

6755 HIGH ENERGY PHYSICS INDEX. Volume 11, No. 8, 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 92p.

6756 HIGH ENERGY PHYSICS INDEX. Volume 11, No. 9, 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 99p.

6757 CONSTRUCTION OF THE SPIN STATES IN DUAL MODELS. Ioffe, M. V.; Novozhilov, Yu. V.; Prokhvatilov, E. V. Vestn. Leningrad. Univ., No. 22, Fiz., Khim.; No. 4, 24-30(Nov 1972). (In Russian).

Intermediate states for definite mass and spin values are considered within the framework of the operator formalism for the generalized Veneziano model. The explicit expressions for the state norms in the factorized 4-particle Veneziano amplitude are obtained. (auth)

6758 INVESTIGATION OF THE SPIN STATES NORM IN DUAL MODELS. Ioffe, M. V.; Novozhilov, Yu. V.; Prokhvatilov, E. V. (Leningrad State Univ.). Teor. Mat. Fiz.; 15: No. 2, 237-244(May 1973). (In Russian).

The norms of intermediate states with the definite mass and spin values in the generalized Veneziano model are investigated by means of the operator formalism. The explicit expressions for the norms of the states in the factorized 4-particle Veneziano amplitude are obtained. (auth)

6759 INCLUSIVE PROCESSES AT HIGH ENERGIES. Ezhela, V. V.; Logunov, A. A.; Mestvirishvili, M. A.; Petrov, V. A. (Inst.

of High Energy Physics, Serpukhov, USSR). Teor. Mat. Fiz.; 15: No. 2, 153-181(May 1973). (In Russian).

The new physical characteristics of inclusive processes are discussed, namely, the average multiplicities of particles in different regions of the phase space. The hypotheses of the pionization, scaling invariance and limiting fragmentation are analyzed from the viewpoint of the analyticity and unitarity principles. The upper bound for the cross section $d^2\sigma_{ab\to cd}/d \cos \theta d\varphi$ is improved. It is shown that the power energy dependence of the bound obtained cannot be improved further within the chosen assumptions about analyticity. (auth)

Electromagnetic

Refer also to abstracts 6694, 6866, and 7246.

6760 (AERE-PR/NP-18, p 56) NUCLEAR RADIATION PHENOMENA DURING THUNDERSTORMS. Whitehead, C. (Atomic Energy Research Establishment, Harwell, Eng.); Ashby, D. E. T. F. Mar 1972.

6761 (NP-19737) STUDIES IN HIGH ENERGY PHENOMENOLOGY OF TWO-BODY PROCESSES. Froeyland, J. (Oslo Univ. (Norway). Fysisk Institutt). Apr 1972. 87p. Dep. NTIS (U. S. Sales Only) $6.50.

Thesis.

The first paper introduces the field of photoproduction of pseudoscalar mesons and discusses the relations between the polarized target asymmetry, the final state nucleon polarization and the polarized photonasymmetry. It is suggested in paper 2 that Regge–Pomeron cuts may play a dominant role in π photoproduction, while paper 3 extends the ideas of paper 2 to π^0 photoproduction. An attempt is made in paper 4 to use the ideas of paper 2 in K^+ photoproduction. In paper 5 contains a method of checking the absolute normalization of the differential cross sections in np charge exchange scattering and the line reversed reaction $\bar{p}p \to \bar{n}n$ and a critical discussion of various types of Regge models. Finally paper 6 contains studies of several isospin bounds. (NO)

6762 CHARGE ASYMMETRY OF MUON ANGULAR DISTRIBUTION IN $e^+e^- \to \mu^+\mu^-$ PROCESS. Khriplovich, I. B. (Inst. of Nuclear Physics, Novosibirsk, USSR). Yadern. Fiz.; 17: No. 3, 576-581(Mar 1973). (In Russian).

Charge asymmetry in angular distribution of muons, produced by electron–positron collisions were calculated. The contribution of radiative corrections to the effect turns out to be large enough; even at the energy of each beam E = 4.5 GeV it is considerably higher than that of hypothetic weak interaction with the constant equal to a usual Fermi one. (auth)

6763 APPLICATION OF THE PION GAUGE CONDITION AS A MASS EXTRAPOLATION CONSTRAINT. Csikor, F. (Eoetvoes Lorand Univ., Budapest). Lett. Nuovo Cim.; 6: No. 17, 717-718 (28 Apr 1973).

A relation between the nucleon isovector charge form factor ($F_1^v(k^2)$) and the axial vector form factor ($G^A(k^2)$) was previously obtained by imposing the pion gauge condition and PCAC together as exact requirements at vanishing pion four-momentum. The possibility whether the equation $F_1^v(k^2)/F_1^v(0) = G^A(k^2)/G^A(0)$ can hold as an exact analytic equation for $k^2 < 0$ is investigated. (LBS)

6764 THEORY OF SYNCHROTRON RADIATION OF CHARGED POINT PARTICLES POSSESSING DIPOLE MOMENTS. Kukanov, A. B.; Lavrova, G. A. Vestin. Mosk. Univ., Ser. III. Fiz. Astron.; 13: No. 6, 718-721(1972). (In Russian).

Radiation in a transparent isotropic medium with characteristics $\epsilon = \epsilon(\omega)$ and $\mu = \mu(\omega)$ of charged point particles was examined. The latter possessed magnetic and electric dipole moments and moved in helical paths. The problem is related to pulsar phenomena. (KSW)

6765 COMPTON SCATTERING AND THE CHEMISTRY OF MOMENTUM SPACE. Epstein, I. R. (Brandeis Univ., Waltham, MA). Accounts Chem. Res.; 6: No. 5, 145-152(May 1973).

The discussion of the chemistry of momentum space using Compton scattering covers the impulse approximation, the experimental determination of Compton profiles, the calculation of Compton profiles and momentum distributions, and momentum distributions and chemical bonding. (JFP)

6766 DIFFRACTIVE EXCITATION OF PHOTONS AND SUM RULE FOR $\gamma\gamma$ SCATTERING. Budnev, V. M.; Ginzburg, I. F.; Serbo, V. G. (Inst. for Mathematics, Novosibirsk, USSR). Lett. Nuovo Cim.; 7: No. 1, 13-15(5 May 1973).

Two problems that can be solved in studying transitions $\gamma\gamma \to$ hadrons are considered: the contribution to the cross section for the process $\gamma\gamma \to h$ from the diffraction photon excitation; and the sum rule for $\gamma\gamma$ scattering. (LBS)

6767 COMMENT ON THE HADRON MASS DIFFERENCES IN A GAUGE MODEL. Lee, S. Y. (Univ. of California, San Diego, La Jolla). Lett. Nuovo Cim.; 7: No. 1, 5-8(5 May 1973).

It is shown that in Weinberg's $SU_{L\,2} \times U_1$ gauge model the divergent part for the sum of the second-order weak and electromagnetic mass differences for hadrons is equal to $\frac{1}{2} \cos^2 \theta$ times that for the pure electromagnetic case, where θ is the mixing angle in the model. The pion mass difference is considered as an example. (LBS)

6768 ELECTRON FIELD AND THE DIRAC BRACKET. Kalnay, A. J. (Instituto Venezolano de Investigaciones Cientificas, Caracas). Int. J. Theor. Phys.; 7: No. 1-2, 119-127 (Feb 1973).

A recent quantization rule of Fermi systems starts from the new symmetric brackets of classical mechanics. As a consequence, Fermi and Bose quantization can be put on an equal footing, instead of the standard ad hoc procedure. It is proved that the rule gives the right anticommutation relations when applied to the case of the relativistic electron. It is shown that this is a crucial test of the rule. For completeness, Dirac's Hamiltonian mechanics and the plus and minus Dirac bracket formalisms are developed for the electron's field. (auth)

6769 ENERGY-LOSS IN THE CHERENKOV RADIATION. Sen Gupta, N. D. (Tata Inst. of Fundamental Research, Bombay). Ann. Phys. (Leipzig); 28: No. 3, 211-215(1972).

The object is to find the electromagnetic field and the rate of increase of the field energy due to a pair of charged particles soon after their creation. It is shown that in the case of the Čerenkov radiation, there is a constant rate of increase of the field energy. The power spectrum is similar to that obtained in the usual formulation, where the particles are assumed to be moving with uniform velocity since infinite past. (auth)

6770 STABLE MOTION AND ACCELERATION OF A CHARGED PARTICLE IN A LINEARLY POLARIZED ELECTROMAGNETIC WAVE IN A GAS MEDIUM. Nagorskii, G. A.; Orlov, Yu. F. Zh. Eksp. Teor. Fiz.; 64: No. 3, 761-767(Mar 1973). (In Russian).

Mechanisms of stability of the motion of a particle in a transversely polarized electromagnetic wave in a gas medium are considered. In the presence of a stationary magnetic field stable acceleration of particles occurs. (auth)

6771 GALILEAN INVARIANCE AND MAGNETIC MONOPOLES. Bacry, H.; Kubar-Andre, J. (Aix-Marseille Univ., Marseille). Int. J. Theor. Phys.; 7: No. 1-2, 39-47(Feb 1973).

The existence of Dirac monopoles is shown to be incompatible with Galilean invariance. A discussion follows on the interpretation of monopoles physics in a Galilean approximation. (auth)

6772 PHOTON: A COLLECTIVE EXCITATION OF FERMION FIELDS. Des Cloizeaux, J. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys., A (London); 6: No. 5, 597-609(May 1973).

The photon is described as a collective excitation of a fermion field. The basic short range self-interactions of this field are assumed to be gauge invariant and nonlocal. By breaking this symmetry, a one-fermion Green function of the Dirac type can be found. Consequently, a collective excitation of zero mass, that is, the photon, appears as a pole of the two-fermion Green function. Thus the usual electron and photon field theory can be qualitatively reconstructed. (auth)

6773 OKUBO SECOND-ORDER MASS FORMULA FROM SO(6,1). Tait, W. (Univ., Paris). Int. J. Theor. Phys.; 7: No. 1-2, 3-7(Feb 1973).

The study of the unification SO(6,1) as a spectrum generating algebra is continued to include baryons in the scheme. Among others, the second-order mass formula of Okubo for the $\frac{3}{2}^+$ baryon resonances and new mass sum rules for the 1^- and 2^+ meson resonances are derived. (auth)

6774 SYMMETRY PROPERTIES OF DIVERGENCES OF VECTOR CURRENTS. Eliezer, S.; Singer, P. (Imperial Coll. of Science and Tech., London). J. Phys., A (London); 6: No. 5, 661-671(May 1973).

It is proposed to investigate the degree of validity of the octet dominance formulation of the partial conservation of vector currents, recently used by several authors. To this end, possible contributions transforming like a "27" representation of the SU(3) group are assumed for the divergences of vector currents, in addition to the "octet" part represented by scalar mesons. Their magnitude is investigated by solving the equations for the divergences of vector currents with the aid of a perturbation expansion in λ(SU(3) breaking) and e^2(SU(2) breaking). It is shown that "octet dominance" for the SU(3) breaking of the divergences of vector currents can be safely assumed only for certain transitions, while somewhat higher "27" contributions are encountered for other matrix elements as well as in the appropriate SU(2)-breaking case. The Gell-Mann-Okubo mass formulae with electromagnetic corrections for baryons and for pseudoscalar mesons, the electromagnetic mixing angles and the Coleman-Glashow formulae are all reproduced in our solution, and in addition three new hybrid mass formulae are obtained. Finally, the domain of validity of the results is discussed emphasizing which of them turn out to hold for an arbitrary mixture of the usual electromagnetic hamiltonian and a tadpole contribution. (auth)

6775 RELATIVISTIC COMPTON EFFECT FOR BOUND ELECTRONS. Gorshkov, V. G.; Mikhailov, A. I.; Sherman, S. G. (Inst. of Nuclear Physics, Leningrad). Zh. Eksp. Teor. Fiz.; 64: No. 4, 1128-1140(Apr 1973). (In Russian).

A formula for the cross section for scattering of photons by bound electrons involving atomic ionization is derived for incident photon energies considerably exceeding the ionization energy and for low values of αZ. The formula is valid for arbitrary values of momentum transferred to the nucleus and in particular for $q \sim m$. (auth)

6776 INDUCED TWO-PHOTON SYNCHROTRON RADIATION AND COMPTON SCATTERING IN A MAGNETIC FIELD. Zhukovskii, V. Ch.; Nikitina, N. S. (Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 64: No. 4, 1169-1177(Apr 1973). (In Russian).

Compton scattering of photons by electrons in a magnetic field and also stimulated two-photon synchrotron radiation when one of the photons is induced by an external electromagnetic wave are considered. The possibility is demonstrated of self-polarization of the electron spin as a result of Compton scattering in a magnetic field. The correction to the probability for synchrotron radiation due to absorption and emission of photons of the external electromagnetic wave by electrons is calculated. It is demonstrated that if this correction is taken into account in the case of low photon energies the infrared divergence in a magnetic field is compensated in the second order in perturbation theory. (auth)

6777 REGULARIZING ROLE OF A GRAVITATIONAL FIELD. Markov, M. A. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 4, 1105-1110(Apr 1973). (In Russian).

It is shown that an extreme mass or a corresponding cut-off length arises in intermediate states when gravitational interactions are taken into account in quantum electrodynamics. It is asserted that the electron mass cannot be of an electromagnetic nature since the corrections to the electron mass which the electromagnetic field yields are smaller than the experimental mass by several orders of magnitude. The possibility of the appearance in intermediate states of such states which are characterized by a half-closed metric is discussed. (auth)

6778 LIGHT-CONE DOMINANCE OF VERTEX FUNCTIONS FOR COMPOSITE FIELDS AND ASYMPTOTIC BEHAVIOR OF ELASTIC FORM FACTORS. Ciafaloni, M. (CERN, Geneva); Menotti, P. Lett. Nuovo Cim.; 6: No. 14, 545-550(7 Apr 1973).

The model of a hadron described by a composite field is considered, and an attempt is made to analyze in this context the light-cone structure of its vertex functions. It is found that the off-shell vertex function is light-cone dominated for composite fields with regular interaction between constituents. The scaling function has a finite $\omega \rightarrow 1$ limit, and the vanishing of its discontinuity is connected with the fall-off of the elastic form factor by a relation of the same nature as Drell-Yan-West relation. (LBS)

6779 SYNCHROTRON RADIATION, ADIABATIC INVARIANT, GRADIENT DRIFT OF PARTICLES IN LINEARLY INHOMOGENEOUS MAGNETIC FIELD. Kaplan, S. A.; Orazberdyev, Kh.; Trakhtengerts, V. Yu. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 1, 25-29(1973). (In Russian).

Using the exact solution of a charged particle motion in a linearly inhomogeneous magnetic field the spectrum and intensity of synchrotron emission of these particles, the total radiation power, adiabatic invariants describing the change of one motion parameters depending on the change of the others (for example, the approach of a particle to the neutral line at the radiation energy loss) etc are found. The obtained relations may be used to analyze the particle motion and their radiation near the neutral line of the magnetic field. (auth)

6780 TESTS FOR GENERAL MODELS OF DEEP INELASTIC LEPTON SCATTERING. Bundy, R. V. (Oxford Univ.). Nuovo Cim. 15A: No. 2, 173-188(21 May 1973).

Predictions of weak cross sections and electroproduction moments in various general parton models and equivalently in light-cone algebras are derived and compared with data. Bounds for weak cross sections are given. (auth)

6781 EFFECTS OF VACUUM POLARIZATION IN S-WAVE PROTON–PROTON SCATTERING. Naisse, J. P. (Univ. Libre, Brussels). Bull. Cl. Sci., Acad. Roy. Belg.; 58: 872-893(1972). (In French).

The relatively complicated calculation of all the quantities occurring in the analysis of the effects of vacuum polarization on S-wave proton–proton scattering at low energies is reduced, by the construction of very simple analytic representations, to the calculation of the corresponding quantities in the absence of any effect of vacuum polarization. (2 figures, 7 tables) (tr-auth)

6782 IZLUCHENIE RELYATIVISTSKIKH ELEKTRONOV. (Radiation of Relativistic Electrons). Baier, V. N.; Katkov, V. M.; Fadin, V. S. Moscow; Atomizdat (1973). 374p.

Bremsstrahlung and pair production during the passage of high-energy particles through an external field or during the encounter of high-energy charged particles are discussed, allowing for polarization and spin effects. Features of electromagnetic processes at high energies are examined. Classical and quantum theories of radiation are applied to ultra-relativistic particles, radiation in macroscopic external fields and a Coulomb field. 126 references. (KSW)

6783 NEW POSITION OPERATOR FOR THE PHOTON. Bertrand, J. (Univ., Paris). Nuovo Cim.; 15A: No. 2, 281-292 (21 May 1973).

It is shown how to construct a position operator for the photon in its own reference system. This operator is Hermitian and has commuting components. (auth)

6784 INELASTIC ELECTRON–PROTON SCATTERING WITH A DYNAMICAL GROUP. Akcay, H. (Middle East Technical Univ., Ankara). Nuovo Cim.; 15A: No. 2, 305-315(21 May 1973).

The resonance model is used to analyze the inelastic electron–proton scattering. The resonances are described by a dynamical-group model. The rapid decrease for the transition form factors for large values of momentum transfer can be obtained and it can be shown that all resonances fall off according to a dipole formula. The existence of the Bjorken limits for the structure functions is investigated and it is shown that the model gives finite Bjorken limits for the functions $F_1(\omega)$ and $F_2(\omega)$. The threshold behavior of these functions is studied and the Drell-Yan formula is obtained. (auth)

6785 ELASTIC SCATTERING OF ELECTRONS BY PROTONS AND WEAK NEUTRAL CURRENTS. Kerimov, B. K.; Samsonenko, N. V. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 132-137(Jan 1973). (In Russian).

The differential cross section for elastic scattering of nonpolarized and longitudinally polarized electrons with high energies by a polarized proton target was calculated; a possible weak interaction of neutral ($\bar{e}e$) and ($\bar{p}p$) currents was taken into account. (tr-auth)

6786 TIMELIKE CURRENTS AND THE PION FORM FACTOR. Glueck, M.; Petzold, J. (Univ., Marburg, Ger.). Nuovo Cim.; 15A: No. 2, 244-248(21 May 1973).

Requiring the e.m. current of the pion to be timelike imposes restrictions on its electric form factor. These restrictions are found to be violated by the experimental data. (auth)

6787 INFRARED DIVERGENCES AND ADIABATIC SWITCHING. II. Radiative Corrections to Coulomb Scattering. Barbieri, R. (Scuola Normale Superiore, Pisa, Italy); Remiddi, E. Nuovo Cim.; 15A: No. 2, 162-172(21 May 1973).

The method, developed in a previous work, is extended to the evaluation of second-order radiative corrections to the Coulomb scattering differential cross section. Virtual and real photons are always given exactly zero mass and are described in terms of the same integration variable, avoiding the usual artificial distinction between "elastic" and "bremsstrahlung" contributions. The homogeneity of the approach allows one to obtain an analytic expression for the differential cross section which is notably simpler than those already existing in the literature. (auth)

6788 ELECTROPRODUCTION AND ANNIHILATION IN THE DEEP-INELASTIC LIMIT. Ezawa, Z. F. (Tokyo Univ.). Nucl. Phys.; B56: No. 1, 52-60(1973).

It is shown, in a specific field theory, that the electroproduction and annihilation structure functions yield the same threshold behaviors, i.e., if $\bar{F}(\omega) = C(1-\omega)^{\gamma}$, then $F(\omega) = C(\omega-1)^{\gamma}$, where γ is not an integer in general. (auth)

6789 PHOTON GREEN FUNCTION. Kirzhnits, D. A.; Kryuchkov, G. Yu. (Lebedev Inst. of Physics, Moscow). Teor. Mat. Fiz.; 15: No. 2, 227-236(May 1973). (In Russian).

The expression for the photon Green function is found, which possesses correct analytical properties and is valid not only in the asymptotical region, but for the small momenta as well. In the region of the momenta $q^2 \ll m^2 \exp(3\pi/\alpha)$ the new expression differs from the usual one by the exponentially small terms of the order $\exp(-3\pi/\alpha)$. (auth)

Weak

Refer also to abstracts 6553 and 6867.

6790 (CERN/ECFA -72/4(Vol.2), pp 85-123) NEUTRINO PHYSICS. Jan 1973.

In ECFA: 300 GeV Working Group.

The discussion of neutrino physics covers the phenomenological theory, possible theories of weak interactions, and neutrinos as probes of hadron structure, the use of transverse momentum balance as a means of estimating the energy of interacting neutrinos, and track-sensitive targets for neutrinos in BEBC. (JFP)

6791 SINGLE-PARTICLE EXCHANGE MODELS OF WEAK LEPTON INTERACTIONS. Leptonic Processes. Guliev, N. A.; Dzhafarov, I. G. (Inst. of Physics, Baku). Yadern. Fiz.; 17: No. 3, 567-575(Mar 1973). (In Russian).

A possibility to describe weak lepton interaction with single particle exchange model, which leads to usual 4-fermion V–A version at small momentum transfer, is considered. Analysis of possible versions shows, that there exist three types of interactions: by traditional vector W-boson exchange, scalar B-particle, introduced by Tanikawa–Watanabe and by vector X-particle which has both electron and muon leptonic charges at once. Expressions for positron (electron) spectrum in μ-decay are presented, where restrictions for masses of intermediate W, B, and X particles have been obtained. From experimental limits for constants of neutral current interactions and from comparison of the obtained theoretical expressions for muon life-time in three models with the experimental data, restrictions are obtained for coupling constants, going into Lagrangians of the models under discussion. Differential and total cross sections for all the four particle scatterings and annihilation in three models were calculated. Characteristic resonance reactions are pointed out. (auth)

6792 FILIPPOV'S THEORY OF UNIVERSAL WEAK INTERACTION OF LEPTONS. Goswami, D. N. (National Research Council of Canada, Ottawa). Lett. Nuovo Cim.; 6: No. 17, 722-724(28 Apr 1973).

A theory of universal weak interaction of leptons was proposed by Filippov where leptons and antileptons are described by spinors in a four-dimensional leptonic isospace. It is shown that the upper limits for the $\nu_e + e$ and $\bar{\nu}_e + e$ cross sections are compatible with the prediction of the universal-weak-interaction theory. (LBS)

6793 CHARGE SYMMETRY AND QUARK–PARTON MODEL. Kim, B. R.; Rodenberg, R. (Technical Univ., Aachen). Lett. Nuovo Cim.; 6: No. 17, 719-721(28 Apr 1973).

The question of whether quark–parton models are compatible with present data of deep inelastic lepton–nucleon scattering is investigated. It is shown that the quark–parton models seem to be excluded by the present data if one maintains the charge symmetry of the nucleons. (LBS)

6794 MODELS FOR NONLEPTONIC WEAK HYPERON DECAYS. Gavroglu, K.; Scadron, M. D. (Imperial Coll. of Science and Tech., London). Nuovo Cim.; 14A: No. 4, 812-826 (21 Apr 1973).

Different models are investigated for nonleptonic weak hyperon decays, and it is found that only hard-pion current algebra with the inclusion of decuplet poles and $\langle B|H_W^{p.v}|B'\rangle = 0$ gives a consistent description for both types of decays, $B_i \rightarrow B_f\pi$ and $B_i \rightarrow B_f\gamma$. It is also shown that the resulting strength and d'/f' ratio of the phenomenological weak spurion ($d'/f' = -0.86$) are consistent with models which dynamically generate the weak spurion. The pole model and soft current algebra with a nonvanishing parity-violating spurion are also considered but are inconsistent with $K_s \rightarrow \pi\pi$ and the sign and magnitude of the measured $\Sigma^+ \rightarrow p\gamma$ asymmetry parameter. (auth)

6795 UNIVERSALITY IN FERMI β-DECAY. Wilkinson, D. H. (Oxford Univ.). Comments Nucl. Particle Phys.; 5: No. 5, 135-143(1972).

For many years it has been realized that the intrinsic strengths of nucleon β-decay and of muon decay are about the same, and it has been believed that the weak coupling constant, g_μ, that determines the rate of muon decay is exactly the same as g_β, which determines nucleon β-decay. Consideration of the microscopic situation, however, leads to difficulty. The muon is only very sparsely clad with other vertical particles and decays almost alone. On the other hand the nucleon is richly and permanently clad with an entourage of hadronic things that can β decay, and it can scarcely be expected to β decay in an exactly similar way to the muon; if it does this can only be the result of a universality such as that described. (UK)

6796 $\mu^+\mu^-$- and $e^+\mu^-$-PAIR DIRECT PRODUCTION IN NEUTRINO BEAM. Makeev, V. V.; Nevskii, P. L.; Nikitin, Yu. P.; Rozhnov, G. V.; Sokolov, A. A. (Moscow Engineering Physics Inst.). Yadern. Fiz.; 17: No. 4, 805-809(Apr 1973). (In Russian).

In connection with the neutrino experiment projects in the Institute of High Energy Physics the differential and total cross sections of the process $\nu_\mu + Z \rightarrow l^+ + \mu^- + \nu + Z$ on nucleons and on C, F, Br nuclei contained in freon was calculated. The mechanisms of coherent, noncoherent and deep inelastic production were taken into account. The main contribution of the process is given by the coherent production of leptonic pairs. The contribution of the noncoherent production on the freon molecule is 20%, the contribution of the deep inelastic mechanism is 2%. (auth)

6797 POSSIBILITIES TO STUDY THE REACTIONS OF INELASTIC $\nu_e e$ SCATTERING IN HIGH ENERGY NEUTRINO BEAMS. Folomeshkin, V. N.; Khlopov, M. Yu. (Inst. of High-Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 17: No. 4, 810-812 (Apr 1973). (In Russian).

Some possible reactions of inelastic scattering of electron antineutrino on electron, e.g., the reactions $\bar{\nu}_e e \rightarrow \pi\pi$, $K\pi$, KK, 3π, 4π, $K\pi\pi$, $\bar{\nu}_\mu \mu$, $\bar{\nu}_\lambda \lambda$ are discussed. (auth)

6798 LEPTONIC CHARGE CONSERVATION. Shchepkin, M. G. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 17: No. 4, 820-829(Apr 1973). (In Russian).

The effects due to possible violation of the lepton conservation law are considered. The Gribov–Pontekorvo model is used which makes it possible to describe a wide range of phenomena. Using the chosen model the characteristics of various processes are calculated. The restrictions on the parameters which characterize the lepton nonconservation degree are found from experimental data. (auth)

6799 WEAK INTERACTION AND THE SELF-CONSISTENT THEORY. Raychaudhuri, P. (International Centre for Theoretical Physics, Trieste, Italy); Bandyopadhyay, P. Lett. Nuovo Cim., 7: No. 1, 9-12(5 May 1973).

It was previously shown that when the effect of the conventional V–A current–current coupling theory for the weak interaction of leptons is incorporated in the self-consistent theory of quantum electrodynamics, it leads to a contradiction with experimental data. It is shown that if a new theory of weak interactions based on the photon-neutrino weak coupling and dynamical origin of charge is introduced instead of the conventional V–A theory, no such contradiction arises. (LBS)

6800 $\Delta I = 3/2, 5/2$ CONTRIBUTIONS IN $K \rightarrow 2\pi$ DECAYS AND $(\Delta_0 - \Delta_2)$ S-WAVE $\pi-\pi$ PHASE SHIFTS. Sarker, A. Q. (Queen Mary Coll., London). J. Phys., A (London); 6: No. 5, 672-684 (May 1973).

The $\Delta I = 3/2, 5/2$ contributions to the $K \rightarrow 2\pi$ (CP conserving) decay amplitudes due to both the virtual electromagnetic and the intrinsic $\Delta I = 3/2$ weak interaction effects are calculated. The electromagnetic contributions are calculated within a model from the pion and kaon electromagnetic mass differences and their total sum can be made finite at the physical point of the amplitudes although they are individually divergent. The $\Delta I = 3/2$ weak interaction effect is related to the coefficient of the divergent part of the pion electromagnetic mass difference. The predicted values of the total amplitudes and also that of the S-wave π-π phase shift $(\delta_0 - \delta_2)$ are found to be in good agreement with their experimental values. (auth)

6801 DEEP INELASTIC NEUTRINO–NUCLEON SCATTERING AND FINITE–ENERGY SUM RULES. Zerbini, S. (Univ., Bologna). Lett. Nuovo Cim.; 6: No. 16, 643-648(21 Apr 1973).

The derivation of fixed or quasi-fixed mass sum rules by a previously suggested method for deep inelastic neutrino-nucleon scattering when the nucleon spin is not summed over is examined. Some new finite-energy sum rules are derived in addition to some previously derived. The contributions of the disconnected state and their relative importance are directly estimated. (LBS)

6802 TESTS OF SECOND CLASS CURRENTS IN SEMI-LEPTONIC WEAK INTERACTIONS. Brown, S. M. Baltimore;

Johns Hopkins Univ. (1972). 148p. University Microfilms Order No. 73-12,119.

Thesis (Ph.D.).

Tests for the presence of second class currents in the current x current theory of semi-leptonic weak interactions are presented and examined. The theoretical structure necessary for an understanding of second class currents is developed, with particular care given to the interrelation between the G-parity, time reversal and charge symmetry transformations. Reaction rates, energy spectra and angular correlations are computed for beta decay, muon capture, and inelastic neutrino scattering processes. It is shown that, depending upon the particular kinematics, certain terms in these expressions reflect the presence or absence of second class currents. Calculations are performed using the elementary particle treatment of nuclei to eliminate the need for consideration of the "off-shell" contributions which arise in most composite nuclear models of weak interactions. Reactions are classified according to the leptons taking part and according to the spin (J) and parity (P) of the initial and final hadron states: $J_i^P \rightarrow J_f^P$. The beta decay processes considered are the mirror $1^+ \rightarrow 0^+$ decays $^{12}B \rightarrow {}^{12}C + e^- + \bar{\nu}_e$ and $^{12}N \rightarrow {}^{12}C + e^+ + \nu_e$, and the $\frac{1}{2}^+ \rightarrow \frac{1}{2}^+$ mirror decays $\Sigma^{\mp} \rightarrow \Lambda^0 + e^{\mp} + \bar{\nu}_e(\nu_e)$. The muon capture processes treated are the $\frac{1}{2}^+ \rightarrow \frac{1}{2}^+$ reactions $\mu^- + p \rightarrow n + \nu_\mu$ and $\mu^- + {}^3He \rightarrow {}^3H + \nu_\mu$. The $\frac{1}{2}^+ \rightarrow \frac{3}{2}^+$ inelastic neutrino scattering processes $\nu_\mu + N \rightarrow N^* + \mu^-$ and $\bar{\nu}_\mu + N \rightarrow N^* + \mu^+$ are also considered. Estimates are made of the size of second class current effects. (Diss. Abstr. Int., B)

6803 POLARIZATION PROPERTIES OF LEPTONS TAKING PART IN SOME WEAK ELECTROMAGNETIC PROCESSES. Romanov, Yu. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 138-142 (Jan 1973). (In Russian).

Longitudinal spin correlations were studied for the radiative decay of a muon according to $\mu^- \rightarrow e^-\tilde{\nu}_1\tilde{\nu}_2\gamma$ and during the neutrino–antineutrino annihilation of polarized leptons with the formation of a photon: $\mu^+e^- \rightarrow \nu_1\nu_2\gamma$. (tr-auth)

6804 ENERGY SPECTRA, ANGULAR DISTRIBUTIONS OF RECOIL ELECTRONS IN $\nu e(\tilde{\nu}e)$ SCATTERING, AND THE WEAK INTERACTION OF PHOTONS WITH THE NEUTRINO. Gnedov, Yu. A.; Romanov, Yu. I. Izv. Akad. Nauk SSSR, Ser. Fiz., 37: No. 1, 207-210(Jan 1973). (In Russian).

Neutrino(antineutrino)–electron scattering was examined in the approximation that these processes may be realized because of four-particle interaction and weak interaction of photon with neutrino. Energy spectra of recoil electrons during $\nu e(\tilde{\nu}e)$ scattering were obtained with polarization of the initial electron taken into account. The process of emission of a neutrino–antineutrino pair during the annihilation of electrons and positrons was considered. (tr-auth)

6805 GRAVITATION AND FINITE RENORMALIZATION OF MUON MASS IN QUANTUM FIELD THEORY. Abdullaev, F. Kh. (Inst. of Nuclear Physics, Tashkent). Yadern. Fiz.; 17: No. 4, 862-865(Apr 1973). (In Russian).

The consideration for anomalous interaction of muons with neutral pseudoscalar massive meson χ and gravitational field in the framework of some model leads to a finite eigenmass of muon. In the second order in χ-interaction constant a correction for mass is 0.2 from the observed one at $g_x^2 = 6e^2 = 6/137$ and $M_x = (1$ to $100)m_{nucl}$. (auth)

6806 CROSS SECTIONS ON INELASTIC WEAK PROCESSES ON COLLIDING LEPTON–LEPTON BEAMS. Bogomol'yni, E. B.; Nikolaev, N. N.; Novikov, V. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 17: No. 4, 813-819 (Apr 1973). (In Russian).

The cross sections of the inelastic weak processes $ll \rightarrow ll\bar{\nu}\nu$, $l = e^{\pm}, \mu^{\pm}$ at high energies are calculated. (auth)

6807 PION POLE DOMINANCE IN LIGHT-CONE PHYSICS. Valenti, G. New York; New York Univ. (1972). 70p. University Microfilms Order No. 73-11,780.

Thesis (Ph. D.).

The implications of the newly developed light cone techniques on the problems of pion pole dominance in the kaon semileptonic decays, $K^{\pm} \rightarrow \pi^-\pi^+e^{\pm}\nu$, and the low energy pion-pion scattering are examined. In the usual PCAC framework, the information obtained for these processes from current algebra, in the soft pion limit ($p \rightarrow 0$), are extrapolated to the mass shell ($p^2 = \mu^2$) assuming that the amplitude has a smooth behavior in p^2. Recent theoretical advances, however, have led to a different formulation ("weak" PCAC) of the underlying algebraic symmetries governing weak and strong interactions. In this framework such smooth extrapolation cannot be always assumed. The development of the light cone techniques based on the existence of operator product expansions near the light cone, has offered a way of explicitly determining the off-shell mass behavior of an amplitude, thus allowing a more convincing extrapolation procedure. In the analysis, Regge theory as well as operator product expansions near the light cone are used to control energy and mass dispersion relations. The result is an explicit form for the dependence of the amplitude in the mass variable p^2 valid between $p^2 = 0$ (current algebra point) and $p^2 = \mu^2$ (on-shell value). Thus, for the K_{l4} decays, it is found that there exists a relation between the extrapolation of two of the axial-current invariant form factors G_1 and G_2. The result, in excellent agreement with experimental data available, is that only the form factor with a bad high energy behavior at infinity receives sizeable corrections from the light cone, as expected. For the π-π scattering, the result is summarized in terms of a correction to the Weinberg π-π scattering lengths. Weinberg has calculated the π-π scattering lengths assuming current algebra, $(3,\bar{3})$ symmetry breaking, an expansion to first order in the energies s, t, u, and mass variables q_i^2, and a strong form of pion pole dominance. It is shown that essentially the same scattering lengths are obtained if the strong pion pole dominance and expansion in q_i^2 assumptions are replaced by a much weaker form of pion pole dominance. (Diss. Abstr. Int., B)

6808 LOWER BOUND ON HEAVY-LEPTON PRODUCTION BY NEUTRINOS. Llewellyn Smith, C. H. (CERN, Geneva). Nucl. Phys.; B56: No. 1, 325-332(1973).

A lower bound on $\sigma(\nu A \rightarrow M\ldots)$ is given, in terms of the structure functions which can most easily be measured in $\nu + A \rightarrow \mu + \ldots$ reactions, for heavy leptons (M) of the type required by renormalizable models of weak interactions. (auth)

6809 $K \rightarrow 3\pi$ AND POLE DOMINANCE. Bennett, G. W. (Univ. of Durham, Eng.). Nucl. Phys.; B56: No. 1, 136-144(1973).

The rate problem in the pole-dominance description of the decay $K \rightarrow 3\pi$ is reexamined. A satisfactory description of both the rate and the spectrum for the decay is obtained. (auth)

Strong (General)

Refer also to abstract 6881.

6810 (COO–2271-4) PRODUCTION PROCESSES AT HIGH ENERGY. Mueller, A. H. (Columbia Univ., New York. Dept. of Physics). 1972. 56p. (CONF-720954–21). Dep. NTIS $5.00.

From 16th international conference on high energy physics; Batavia, Illinois, USA (6 Sep 1972).

A brief description is given of the short range correlation models and the fragmentation models and their essential characteristics. A detailed comparison is then given of the predictions and differences between the two models. (LBS)

6811 (ITF–73-30-E) QUASI-INDEPENDENT QUARK MODEL AND HADRON ELECTROMAGNETIC FORMFACTORS AT LARGE TRANSFERRED MOMENTA. Dushenko, V. F.; Kobushkin, A. P. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

The asymptotic behavior of electromagnetic bound state form factors of three scalar quarks at large transferred momenta k^2 in a quasi-independent quark model is investigated. An agreement of the model with the dipole approximation is found. (auth)

6812 (SU–4205-11) SU(3) BREAKING AND PARTICLE PRODUCTION. Amann, R. F.; Blackmon, M. L. (Syracuse Univ., N. Y. Dept. of Physics). Dec 1972. 13p. (COO–3533-11). Dep. NTIS $3.00.

The effects upon measured particle production ratios of the electromagnetic and weak decays of directly produced particles are discussed. The importance of η production as a source of γ's, and of K_s production as a source of $\pi^{\pm}$'s, is discussed. The f-dominated Pomeranchukon model is explored as a possible source of η and K suppression. The predicted suppressions are however only of order .6; thus η and K production are predicted to be important at high energies, and consequently $\langle n_\gamma \rangle$ is predicted to significantly exceed $\langle n_{\pi^+} \rangle + \langle n_{\pi^-} \rangle$ at high energy. (auth)

6813 ROLE OF NUCLEONS IN HIGH-ENERGY HADRON COLLISIONS. Ginzburg, I. F. (Inst. of Theoretical Physics, Kiev). Lett. Nuovo Cim.; 6: No. 15, 603-607(14 Apr 1973).

It is shown that in the γ^5 model for high-energy hadron collisions the contributions of the one-meson exchange and the one-baryon exchange are approximately equal and the role of one-baryon-exchange increases with the increase of the relative fireball motion rapidity. The following predictions of the γ^5 model are also given: a) a multiperipheral production of particles with one-baryon and one-meson exchange is predominant at high energies; b) the mass of a fireball and the number of particles contained in it cannot be small; and c) on the average one baryon or antibaryon is produced in any fireball. (LBS)

6814 POMERANCHUK POLE PROPERTIES, DIFFRACTIONAL SCATTERING, AND ASYMPTOTIC EQUALITY OF TOTAL CROSS SECTIONS. Gribov, V. N. (Inst. of Nuclear Physics, Leningrad). Yadern. Fiz.; 17: No. 3, 603-613(Mar 1973). (In Russian).

It is shown, that for self-consistent description of total cross section asymptotic constancy with Pomeranchuk pole one should consider that total cross sections for interactions of any hadrons tend to the same limit with energy growth. The analogy of this phenomenon to diffraction on extended objects and a possible picture of the interaction, which leads to such universality, are discussed. (auth)

6815 PROPERTIES OF INCLUSIVE REACTIONS IN A UNITARIZED MODEL OF PRODUCTION AMPLITUDES. Tye, S. H. H. (Massachusetts Inst. of Tech., Cambridge); Veneziano, G. AT(11-1)-3069. Nuovo Cim.; 14A: No. 4, 711-764 (21 Apr 1973).

Inclusive cross sections are studied in the planar dual model by first constructing a unitarized set of production amplitudes. Total cross sections, and single- and many-particle spectra are then constructed, and conservation laws are imposed through a set of sum rules. A weak form of the Harari–Freund conjecture for total cross sections is derived and is easily generalized to single- (and many-) particle spectra. A large number of predictions is obtained for single-particle spectra, many of which are capable of experimental verification. Inclusive experiments on deuterium targets are urged in order to provide a crucial test of the model. Using a stronger form of the Harari–Freund conjecture as an input, predictions are obtained for the way single-particle spectra approach scaling. Criteria for early scaling, and for rising and falling inclusive cross sections, are discussed in detail. Diffraction dissociation is included in a very natural way. Effects of interference terms, cuts and absorption are briefly discussed, and it is argued that they cannot change the general results obtained. (auth)

6816 SHORT-DISTANCE LIMIT OF STRONG INTERACTIONS. Domokos, G.; Koevesi Domokos, S. (Johns Hopkins Univ., Baltimore). AT(11-1)-3285. Nuovo Cim.; 14A: No. 4, 667-691(21 Apr 1973).

The problem of the short-distance behavior of strong interactions is approached through a study of scattering amplitudes in co-ordinate representation. It is conjectured that a) strong interactions do not die out in the short-distance limit, b) the short-distance limit of scattering amplitudes is covariant under conformal transformations of Minkowski space. Explicit representations are found for the scattering amplitudes in the short-distance limit. Those amplitudes are dual in a weak sense and are free of ultraviolet divergences. Detailed study of a simple example reveals a physically reasonable connection between the threshold and Regge regions of inelastic structure functions. On the basis of simple models it is conjectured that results found in the short-distance limit are not destroyed by the long-range part of strong interactions: thus a close connection between light-cone behavior and duality may be found. (auth)

6817 ALGEBRA OF REGGE RESIDUES. Kleinert, H. (Freie Univ., Berlin). Lett. Nuovo Cim.; 6: No. 14, 583-586 (7 Apr 1973).

It is shown that the couplings of Regge trajectories to hadrons display a simple algebraic structure. The structure constants of this algebra are supplied by the vertices of three reggeons at zero mass. The subalgebra fulfilled by the trajectories of vector and tensor mesons is derived. (LBS)

6818 POMERON IN DAMA. Bugrii, A. I.; Enkovskii, L. L.; Kobylinskii, N. A.; Shelest, V. P. (Inst. of Theoretical Physics, Kiev). Lett. Nuovo Cim.; 6: No. 14, 577-582(7 Apr 1973).

The inclusion of the pomeron in dual models with Mandelstam analyticity is discussed, using the approach where the pomeron is assumed to be dual to the background, and the pomeron, the background, and exotic states are considered as objects of similar nature with effective trajectories called β-trajectories. The asymptotic behavior of the amplitude is investigated for the cases of a simple-pole, double-pole, and triple-pole pomeron. The singularities dual to the pomeron are also discussed. (LBS)

6819 QUANTUM DYNAMICS OF A MASSLESS RELATIVISTIC STRING. Goddard, P. (Univ. of Durham, Eng.); Goldstone, J.; Rebbi, C.; Thorn, C. B. Nucl. Phys.; B56: No. 1, 109-135(1973).

The classical and quantum mechanics of a massless relativistic string, the light string, which is characterized by an action proportional to the area of the world sheet swept out by the string in space time are developed. It is shown that, classically, there are only D-2 dynamically independent components among the D functions $x^{\mu}(\sigma,\tau)$ which represent the world sheet (D is the dimension of space time). Quantizing only these independent components, it is found that the angular momentum operators suggested by the correspondence principle generate $O(D-1,1)$ only when the first excited state is a photon, i.e., a spin-one massless state, and when $D = 26$. By allowing additional degrees of freedom in the quantum mechanics, the string was quantized in a Lorentz covariant manner for any value of D and any mass for the first excited state. In this latter scheme the full Fock space contains negative norm states. However, when $D \leq 26$ for a massless first excited state and $D \leq 25$ for a real massive first excited state, the physical states span a positive subspace of the Fock space. The excitation spectrum of the light string coincides with the space of physical states in the dual resonance model for unit intercept of the leading Regge trajectory. The connection of this work to previous studies of the physical states in dual models is pointed out. (auth)

6820 MULTIPLICITY DISTRIBUTIONS IN A MULTIPERIPHERAL FIREBALL MODEL. Kripfganz, J.; Ranft, G.; Ranft, J. (Karl-Marx-Univ., Leipzig). Nucl. Phys.; B56: No. 1, 205-226 (1973).

Multiplicity distributions are studied in the thermodynamic model. The approximate Koba, Nielsen, Olesen scaling behavior of the data and Wroblewski's linear law can be understood in the thermodynamic model with multiperipheral production of fireballs. This production mechanism is also essential to understand two-particle rapidity correlations especially in the ISR energy range. There are contributions from diffractive and non-diffractive production of fireballs in the model, which agrees in this sense with the two-component models used recently to discuss multiplicity distributions. In contrast to other models, however, the non-diffractive component taken separately exhibits approximate KNO-scaling and accounts rather well for the behavior of the data up to 300 GeV. For the fireball production mechanism chosen the cross section of the diffractive component is expected to be smaller than in other models and can lead to a two-maxima multiplicity distribution only at energies higher than predicted in other models. (auth)

6821 MULTIPLICITY DISTRIBUTIONS IN THE GENERALIZED FEYNMAN GAS MODEL. Buras, A. J. (Univ. of Copenhagen). Nucl. Phys.; B56: No. 1, 275-286(1973).

Multiplicity distributions $\Psi_n^{(k)}$ in the generalized Feynman gas model of order k (defined by saying that all integrated correlation functions f_n except $f_1, \ldots, f_k$ are zero) are derived and expressed in terms of Poisson distributions with different "average multiplicities," which are related to the integrated correlation functions. The relations between $\Psi_n^{(k)}$ and $\Psi_n^{(j)}$ for arbitrary positive integers k, j are found. An intuitive picture to gain a better feeling for these relations is developed. On the basis of our formulas it is shown that the experimentally observed multiplicity distributions (between 50 GeV/c and 303 GeV/c incoming momentum) can be well reproduced by those of a Feynman gas model of order two. Other applications of the formulas are suggested. (auth)

6822 PHYSICAL STATE PROJECTION OPERATOR IN DUAL RESONANCE MODELS FOR THE CRITICAL DIMENSION OF SPACE–TIME. Brink, L.; Olive, D. (CERN, Geneva). Nucl. Phys.; B56: No. 1, 253-265(1973).

The physical state projection operator for the simple dual resonance model in twenty-six dimensions of space–time and unit intercept in two forms (which are proved to be equivalent). One form obviously projects onto the so-called transverse states and the other obviously gives unity when inserted into any residue of a pole in a dual amplitude. Thus the completeness of transverse states in 26 dimensions is explicitly verified and a method is obtained for constructing genuine unitary dual loop amplitudes. The corresponding results for the Neveu–Schwarz model are presented. (auth)

6823 STATISTICAL BOOTSTRAP OF FIREBALL DECAY SPECTRA. Ilgenfritz, E. M.; Kripfganz, J. (Karl-Marx-Univ., Leipzig). Nucl. Phys.; B56: No. 1, 241-252(1973).

A generalized statistical bootstrap equation for the generating functional of the fireball decay spectra is proposed which includes the bootstrap of the hadronic mass spectrum. In the form of an integral representation a solution is given for some n-particle distributions as well as multiplicity moments in the case of identical particles. Within this formalism decay-chain end effects are discussed and quantum number conservation is treated explicitly. The general equation is approximated by a simpler bootstrap equation for the linear decay chain with quantum-number conservation. An asymptotic solution for the single particle distributions according to this equation is discussed. (auth)

6824 INTRODUCTION OF COMPENSATED FIELDS IN THE DUAL THEORY. Ioffe, M. V. Vestn. Leningrad. Univ., No. 22, Fiz., Khim.; No. 4, 152-155(Nov 1972). (In Russian).

In the functional integral approach to dual theory the fields with arbitrary values of the conformal spin are included. For the action functional being conformal scalar the additional gauge fields are introduced. (auth)

Strong (Baryon No. = 0)

6825 (SU-4205-262) BOUNDS ON THE MOMENTS OF ABSORPTIVE PARTS OF ELASTIC SCATTERING AMPLITUDES. Balachandran, A. P.; Blackmon, M. L.; Sigud, C. (Syracuse Univ., N. Y. Dept. of Physics). Nov 1972. 14p. (NYO-3533-262). Dep. NTIS $3.00.

A rigorous set of bounds on the moments of the absorptive part of elastic scattering amplitudes and of its derivatives with respect to the cosine of the scattering angle is presented for pion-pion and pion-nucleon scattering. These bounds are similar to unitarity bounds found by Singh and Roy and involve integrals over absorptive parts and their derivatives in the physical scattering region only. (auth)

6826 BOUNDS ON MESON REGGE TRAJECTORY FUNCTIONS BELOW THRESHOLD. Kobayashi, R. (Kyoto Univ.). Lett. Nuovo Cim.; 7: No. 1, 16-20(5 May 1973).

A new type of dispersion inequalities which was obtained on the basis of the Phragmen–Lindelöf theorem is applied to a meson Regge trajectory function $\alpha(t)$ by assuming that it is a real analytic function of t and that it has only the unitarity cut on the real axis running from the threshold t_0 to infinity. As an application, the pion trajectory is investigated. (LBS)

6827 CURRENT PROPAGATORS AND SPECTRAL SUM RULES FOR LARGE AND SMALL MOMENTUM. Wienke, B. R. (Los Alamos Scientific Lab., NM). J. Phys., A (London); 6: No. 5, 649-660(May 1973).

Expanding the current propagators in the small and large momentum limit, in both the free field and spectral representations, is shown to lead to Weinberg's first sum rule for SU(3), or U(3), and either the Oakes-Sakurai or Das-Mathur-Okubo sum rules for cases of current or mass mixing, respectively. Resulting mass and coupling constant sum rules are listed for various choices of symmetry breaking and predictions of mixing angle and isovector masses for spin 1 and spin 0 mesons are given. The method also allows systematic introduction of higher order symmetry breaking through the moment spectral integrals. (auth)

6828 EXOTIC BARYONS AND SU_3. Graham, R. H.; Moffat, J. W. (Univ. of Toronto). Lett. Nuovo Cim.; 6: No. 16, 673-674 (21 Apr 1973).

The possible assignments of exotic baryon resonances Z* in SU(3) are investigated. By using the SU(3) mass formula other baryon resonances that can be assigned to the representations containing the Z*'s are predicted. (LBS)

6829 INCLUSIVE REACTIONS AND THE ALGEBRA OF VERTEX STRENGTHS. Koca, M. (International Centre for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 6: No. 16, 649-654(21 Apr 1973).

The algebra of vertex strengths is applied to the one-particle inclusive interactions in the target fragmentation region. Invariant single-particle distributions for any given particle for the projectiles $\bar{p}$, p, π^+, π^-, K^+, K^- and the targets p, n are given and are shown to satisfy linear relations similar to those of the total cross sections. (LBS)

6830 APPLICATIONS OF THE MOMENT PROBLEM. Common, A. K. (Univ. of Kent, Canterbury, Eng.). pp 201-215 of Padé Approximants and Their Applications. Graves-Morris, P. R. (ed.). London; Academic Press Inc. (London) Ltd. (1973).

From conference on Padé approximants; Canterbury, UK (17 Jul 1972). See CONF-720612–.

A review is presented of work dealing with the application of the moment problem in deriving constraints on scattering amplitudes from basic assumptions of crossing unitarity and analyticity. These properties of the scattering amplitude, which hold in the framework of axiomatic field theory, are described in relation to the process $\pi^0(p_1)\pi^0(p_2) \rightarrow \pi^0(-p_3)\pi^0(-p_4)$, although the results can be extended to include processes involving charged pions and other particles. Discussion follows on partial waves and the moment problem, and on constraints on averages of the S wave over the unphysical region. (UK)

6831 SHORT HISTORY OF THE MESON THEORY FROM 1943 TO 1948. Part II. Mukherji, V. (Indian Inst. of Tech., Kharagpur). Indian J. Hist. Sci.; 6: No. 2, 117-134(Nov 1971).

An analytical history is presented of the stages of development of the meson theory of nuclear forces since Yukawa's postulation of the meson field up to 1943, when Sakata's two-meson hypothesis was formulated in the face of the prevailing belief in the identity of the Yukawa meson and the cosmic-ray meson. It starts with a brief description of the persistence of the general idea of a possible connection between nuclear beta-emission and nuclear forces till the abandonment of the attempts to reconcile them. Attempts to postulate a suitable kind of conveyer of nuclear forces culminated in Yukawa's meson hypothesis, although a parallel hypothesis of electron–positron pair field competed with it for some time till experimental confirmations of the existence of a cosmic-ray particle of "intermediate mass" vindicated the meson concept. The new concept found serious advocates as well as skeptic critics. The theoretical invocation of a neutral meson for explaining the experimentally observed charge-independence of nuclear forces was welcome, but still none of the meson theories involving the neutral meson could comprehensively explain all nuclear phenomena. Also, the so-called "mixed" meson theory, which paved the way for a proper two-meson hypothesis, could not save itself against theoretical objections. Theoretical and experimental results on the lifetime and mass of the nuclear meson and of the cosmic-ray meson created great conceptual problems. At that situation the meson-pair theory was invoking the "unobserved" neutral meson. But arguments in favor of the existence of the neutral meson were forthcoming. Although the mixed meson theories foreshadowed a two-meson theory, there was also a parallel trend of reluctance to accept the two-meson picture. Speculations about the strength of the meson-nucleon coupling (weak or strong) could not lead to any definite conclusion till the discovery of the two unlike mesons in 1947. (INIS)

6832 SHORT HISTORY OF THE MESON THEORY FROM 1935 TO 1943. Part I. Mukherji, V. (Indian Inst. of Tech., Kharagpur). Indian J. Hist. Sci.; 6: No. 1, 75-101(May 1971).

The history of the various stages which led to the discovery of the π and μ mesons in 1947, starting from Yukawa's postulation of the meson field years ago, is outlined. Both weak and strong coupling hypotheses were used to get convergence of the two-nucleon interaction potential. Weak coupling had the advantage of relativistic invariance and could overcome the divergence difficulty, but led to a positive magnetic moment for the neutron, contradicting experimental observation. To understand the meson theory better, the n-p scattering problem was re-examined. The experiments of Amaldi et al could not be explained satisfactorily by the non-symmetrical scalar-pseudoscalar meson theories. In the strong coupling limit, these led to the observed angular dependence for high energy n-p scattering, thus leading to the concept of nuclear isobars. The meson pair theory was generalized for spin = 0 and spin = 1, besides spin = $\frac{1}{2}$, but unsatisfactory theoretical results led to the concept of "intermediate coupling". No single theory could satisfactorily explain all nuclear and cosmic ray phenomena and the problem of the mass, life-time and cross-section of mesons could be overcome only by postulating the two-meson hypothesis–"nucleon isobars". This was supported by experimental observation of the heavy π meson and the light μ meson, the latter being the former's decay product and it could also explain the nature of nuclear forces better. The later classification of the μ-meson as a lepton, and the definite proof of the existence of a very heavy τ meson and the neutral π meson has led to a deeper understanding of the nuclear phenomena. (INIS)

6833 RIGOROUS CONSTRAINTS BETWEEN THE LOW PARTIAL WAVES FOR PION–PION SCATTERING. Dita, P. (Inst. of Physics, Bucharest). Nuovo Cim.; 15A: No. 2, 316-326(21 May 1973).

A complete set of rigorous constraints between low partial waves for pion–pion scattering is derived. (auth)

6834 BOUNDS ON THE DERIVATIVES OF THE S AND D PARTIAL WAVES. Dita, P. (Inst. of Physics, Bucharest). Nuovo Cim.; 15A: No. 2, 327-336(21 May 1973).

Upper and lower bounds for the derivatives of the S and D partial waves in terms of the D partial wave are given. These bounds can be improved only by using unitarity. (auth)

6835 MODELS IN HIGH ENERGY PHYSICS. Moen, I. O. Toronto; Univ. of Toronto (1971). National Library of Canada, Ottawa.

Thesis (Ph. D.).

The postulates of S-matrix theory are outlined and it is shown how models for S-matrix elements or transition amplitudes can be constructed. Particular emphasis is given to the difference between dual and generalized interference models. These ideas are then applied to $\pi-\pi$ scattering. The applications of a generalized interference model to $\pi-\pi$ and $\pi-K$ scattering and to the decays $\bar{p}n \rightarrow 3\pi$, $K \rightarrow 3\pi$ and $\eta \rightarrow 3\pi$ are discussed. The model is also extended to reactions involving the X^0 and η; it is particularly successful for the decay $X^0 \rightarrow \eta\pi\pi$. A simple Regge pole description of $\pi N \rightarrow \omega N$ at high energies is also discussed. (Diss. Abstr. Int., B)

6836 $\eta \rightarrow 3\pi$ DECAY AND $\pi\eta$ SCATTERING IN CHIRAL SU(2) × SU(2) SYMMETRY. Ivanov, E. A.; Zupnik, B. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys.; B56: No. 1, 266-274(1973).

The problem of $\eta \rightarrow 3\pi$ decay in chiral SU(2) × SU(2) symmetry is investigated. It is argued that the well-known difficulties of the conventional pole model originate from underestimating the role of the η-meson pole graph. This model is shown to be suitable for describing $\eta \rightarrow 3\pi$ decay if the strong $\eta\eta\pi\pi$ vertex in the η-pole graph is determined by an SU(2) × SU(2)-invariant interaction. The $\pi^0 - \eta$ transition constant $g_{\pi\eta}$ is evaluated from U-spin invariance with the help of a current-mixing model: $|g_{\pi\eta}| \approx 0.05$. It turns out that the experimental data on both the decay widths and the energy spectrum can be satisfied by fitting the value of the $\eta\eta\pi\pi$ coupling constant as a parameter. As a result, predictions for the s- and p-wave $\pi\eta$ scattering lengths are obtained: $|a^0_{\pi\eta}| \approx 0.2\ m_\pi^{-1}$, $|a^1_{\pi\eta}| \approx 0.1\ m_\pi^{-3}$. (auth)

6837 ANALYSIS OF THE DECAY DENSITY MATRIX OF MIXED SCALAR–VECTOR–TENSOR BOSON SYSTEMS. Sekulin, R. L. (Rutherford High Energy Lab., Chilton, Eng.). Nucl. Phys.; B56: No. 1, 227-240(1973).

The asymptotically valid rules which enable one to separate the t-channel components of natural and unnatural parity in quasi-two-body reactions are applied to the case where a mixed scalar-vector-tensor two-boson system is produced. Some model-independent tests for the absence of unnatural-parity exchange are derived. Further tests are devised which are valid when more specific assumptions are made concerning the t-channel exchanges. (auth)

6838 AVERAGE TRANSVERSE MOMENTUM OF PARTICLES PRODUCED IN BARYON-EXCHANGE REACTIONS. Humble, S.; Kaiser, G. D.; White, J. N. J. (Daresbury Nuclear Physics Lab., Eng.). Nucl. Phys.; B56: No. 1, 61-76(1973).

The consequences of the assumption that the mean transverse momentum of pions produced in $\bar{p}p$ annihilations is an increasing function of total energy are examined within the framework of the uncorrelated jet model. Relationships between the mean-square transverse momentum and the mean number of produced pions are derived. A similar study is made of the reaction $\pi^\pm p \rightarrow p$ + pions and $\pi^\pm p \rightarrow p$ + anything, where the final state proton is moving rapidly forward in the lab. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 6745, 6888, and 6919.

6839 (COO-1545-122) TOPOLOGICAL CROSS SECTIONS AND CORRELATION FUNCTIONS IN HIGH ENERGY p p AND π p COLLISIONS. Scott, D. M.; Tanaka, K.; Torgerson, R. (Ohio State Univ., Columbus. Dept. of Physics). 1973. Contract AT(11-1)-1545. 31p. Dep. NTIS $3.75.

A two-component model in which the dominant nondiffractive component possesses Koba, Nielsen and Olesen scaling and the other component is diffractive is studied. This model is fit to the available p p and $\pi^\pm p$ topological cross sections above 10 GeV/c, and is used to make predictions at higher energies. For purposes of comparison, a one-component scaling model is also considered. (auth)

6840 BACKWARD πN SCATTERING AND THE POSSIBLE EXISTENCE OF THE ELEMENTARY NUCLEON. Ginzburg, I. F.; Perlovskii, L. I. (Inst. for Mathematics, Novosibirsk, USSR). Lett. Nuovo Cim.; 6: No. 17, 695-698(28 Apr 1973).

A description is given of backward πN scattering in a model that includes both the Regge trajectories (N_α, N_γ, Δ_δ) and the elementary nucleon, in order to account for the sharp decrease in the differential cross section at high energies. Predictions for πN charge exchange and $\bar{p}p \rightarrow \pi^-\pi^+$ interactions in this model are also given. A possible connection between the elementary nucleon and the N_α trajectory is also considered. (LBS)

6841 ANALYSIS OF DISPERSION RELATIONS FOR HIGH ENERGY PION–NUCLEON SCATTERING. Solov'ev, L. D.; Shchelkachev, A. V. (Inst. of High-Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 17: No. 4, 837-845(Apr 1973). (In Russian).

Real parts of the amplitudes of the forward pion-nucleon scattering in the wide energy range from 10 up to 500 GeV are found from dispersion relations. The calculations are made on the computer BESM-6. The possibility of the constant ratio of real part of πp-scattering amplitude to imaginary one and the role of electromagnetic corrections are studied. (auth)

6842 pp AND π^-p TOPOLOGICAL CROSS SECTIONS IN THE CONTEXT OF A SIMPLE MODEL. Garetto, M.; Giovannini, A. (Univ., Turin). Lett. Nuovo Cim.; 7: No. 1, 35-40(5 May 1973).

The results of the computations of the topological cross sections for pp and π^-p interactions according to a given expression for charge-prong multiplicity distribution are presented, and are compared with the experimental data throughout all the available energy range. (LBS)

6843 π-N BACKWARD SCATTERING AND DUAL ABSORPTIVE MODEL. Gonczi, R. (Univ., Nice). Lett. Nuovo Cim.; 7: No. 1, 21-28(5 May 1973).

It is shown that the dual absorptive model gives a fair description of the differential cross section for backward πN scattering. It is also shown that a slight modification of the model is necessary to account for the polarization in π^+p backward scattering. (LBS) 2

6844 POLARIZATION IN PRODUCTION REACTIONS ON DEUTERONS. Bongardt, K.; Pilkuhn, H. (Univ., Karlsruhe, Ger.). Lett. Nuovo Cim.; 6: No. 14, 541-544(7 Apr 1973).

Formulas are developed for the cross section and Λ polarization in the $K^-d \rightarrow p\pi^-\Lambda$ and $\pi^-d \rightarrow nK^0\Lambda$ interactions, taking into account the double-scattering contribution according to Glauber theory. (LBS)

6845 SCALING BEHAVIOR OF CHARGED-PRONG MULTIPLICITY DISTRIBUTIONS IN HIGH-ENERGY HADRONIC COLLISIONS AND LOCAL EXCITATION MODEL. Buras, A. J.; Koba, Z. (Univ. of Copenhagen). Lett. Nuovo Cim.; 6: No. 16, 629-635 (21 Apr 1973).

It is shown that recent data on pp interactions at 50 to 303 GeV/c, π^-p interactions at 40 and 50 GeV/c, and π^-n interactions at 40 GeV/c are well described by the scaling function $\phi(\omega) = \gamma \exp[-\chi\omega]$. An almost perfect, straight-line fit to the data is obtained. The model of local excitation of hadrons is also briefly discussed. (LBS)

6846 DUALITY IN ELEMENTARY PARTICLE SCATTERING. Schnitzler, D. T. (Wayne State Univ., Detroit). Mich. Acad.; 4: No. 1, 47-52(1971).

The ideas of Regge exchange and duality are applied to the reactions $\pi^- + p \rightarrow \pi^- + p$ and $p + p \rightarrow p + p + \omega$. The total cross sections are discussed. (JFP)

6847 MOMENT PROBLEM AND STABLE EXTRAPOLATIONS WITH AN APPLICATION TO FORWARD Kp DISPERSION RELATIONS. Lopez, C.; Yndurain, F. J. (Univ., Madrid). pp 217-240 of Padé Approximants and Their Applications. Graves-Morris, P. R. (ed.). London; Academic Press Inc. (London) Ltd. (1973).

From conference on Padé approximants; Canterbury, UK (17 Jul 1972). See CONF-720612.

It is shown how Padé approximants can be used in the solution of the so-called Hausdorff moment problem and the Stieltjes-Hilbert problem. An application to the problem of Kp forward dispersion relations is discussed as a practical example. (LBS)

6848 LOW ENERGY PION–NUCLEON SCATTERING. Hackman, R. H. College Park, MD; Univ. of Maryland (1972). 95p. University Microfilms Order No. 73-11,381.

Thesis (Ph. D.).

Integral equations for the off-mass shell S- and P-wave pion-nucleon scattering amplitudes are developed from the Low equation. The "seagull terms," present in this formulation, are calculated using PCAC and current algebra, with the assumption that the pion current is independent of second and higher order derivatives of the pion field. These terms provide the potential for the S-wave equations, as expected, but also modify the rescattering integral. With a cutoff assumption one obtains numerical solutions for the S-wave equations, valid for low energy. Agreement with experiment is surprisingly good. The P-wave equations are not solved, but it is shown that at threshold, they reduce to the Chew-Low equations with potential parameters similar to those of the Chew-Low theory. (Diss. Abstr. Int., B)

6849 FINITE ENERGY SUM RULES ON HYPERBOLAS. Sandusky, J. C. College Park, MD; Univ. of Maryland (1972). 104p. University Microfilms Order No. 73-11,411.

Thesis (Ph. D.).

Finite energy sum rules (FESR's) have been useful in hadron physics as a means to obtain low energy sum rules in cases where amplitudes do not decrease rapidly enough for superconvergence sum rules to be valid, as a means to determine Regge parameters for high energy scattering from low energy data, and as the basis of a linear bootstrap program which led to the notion of duality and to the Veneziano model. Dispersion relations and FESR's on hyperbolas in the real Mandelstam plane were derived which are asymptotic to lines of fixed s and u together with an ellipse on which s and u are complex. The simplest dispersion relation of this type was given by Atkinson for the case of backward πN scattering. These FESR's on hyperbolas are applied to backward and near-backward πN scattering and are used to extract information about the first eight partial waves for the reaction $\bar{N}N \rightarrow \pi\pi$. Concerning this reaction, zeroes above threshold were found for almost all partial waves; also strong evidence for background or daughters in the lower ones ($J \leq 3$). For $J = 4$ and 5, daughters are less evident. Application to Regge residue parameters for P′ and ρ suggest these residues "turn over" at large, positive t but do not change sign. Further, the values favor ρ-f exchange degeneracy for the spin flip case and a simple form of exchange degeneracy breaking for the nonflip case. Values for the P′ residues indicate the $A^{(+)}$ amplitude does not satisfy an unsubtracted dispersion relation. (Diss. Abstr. Int., B)

6850 NEW RELATIONS FOR TWO-BODY REACTIONS FROM INCLUSIVE FINITE-MASS SUM RULES. Hoyer, P. (Oxford Univ.); Roberts, R. G.; Roy D. P. Nucl. Phys.; B56: No. 1, 173-193(1973).

Finite-mass sum rule and duality considerations for the inclusive process $ab \rightarrow cX$ lead to a number of interesting relations among the quasi-two-body cross sections $ab \rightarrow cd_i$, where d_i denotes the prominent resonances in the missing-mass channel. The processes $\pi(\bar{K})N \rightarrow NX$ are studied in detail, and the main results are the following: (i) A superconvergence relation for reggeon (ρ)-particle (π) scattering gives a sum rule connecting the ρ-exchange cross sections $(d\sigma/dt)[\pi^- p \rightarrow (\pi^0, \omega, A_2^0)n]$. (ii) Semi local duality considerations in reggeon-particle scattering relate the resonance production cross section $(d\sigma/dt)[\pi(\bar{K})N \rightarrow N\, d_i]$ to the resonance mass in terms of the trajectory $\alpha(t)$ of the exchanged reggeon. From this the two following corollaries follow: (iii) The ratio of π to $(f-\omega)$ exchange contributions increases linearly with the resonance $(\text{mass})^2$. (iv) The resonance production cross sections get less peripheral with increasing resonance mass. All the above predictions agree reasonably with the available data on mesonic resonance production. (auth)

6851 PERIPHERAL PARTIAL WAVES IN KAON–NUCLEON SCATTERING. Alcock, J. W.; Cottingham, W. N. (H. H. Wills Physics Lab., Bristol, Eng.). Nucl. Phys.; B56: No. 1, 301-307 (1973).

A detailed and critical calculation is presented of the partial-wave amplitudes with large angular momentum in kaon–proton scattering up to a lab momentum of 3.2 GeV/c. (auth)

6852 HYPERON SYSTEMS WITHOUT SATURATION AND THE POSSIBILITY OF THE TRANSFORMATION OF NUCLEI INTO COLLAPSONS. Filimonov, V. A. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 119-122 (1972). (In Russian).

Binding energy of a system of Λ-hyperons was calculated as a function of the baryon number A from the hypothesis that force couples are acting between Λ-hyperons and are identical in all orbital states. At large A values the system becomes a compact object, resembling a strongly interacting elementary particle. Such objects are referred to as collapsons. When $A \gtrsim 50$, the collapson is stable, but the nuclei prove to be unstable toward a conversion into a collapson with a lifetime of $\sim 10^{593}$ years. This lifetime is so large that a similar collapse of the nuclei must be considered impossible. Other processes are discussed in which collapsons might be formed. (tr-auth)

6853 MULTICHANNEL ANALYSIS OF $\bar{K}N$ DATA 0.4 TO 1.2 GeV/c. Lea, A. T. (Rutherford High Energy Lab., Chilton, Eng.); Martin, B. R.; Moorhouse, R. G.; Oades, G. C. Nucl. Phys.; B56: No. 1, 77-89(1973).

An energy-dependent multichannel analysis of $\bar{K}N$ data in the momentum range 0.44–1.19 GeV/c was made using parameterizations based on the K-matrix. Amplitudes and resonance parameters for the S, P, D, and $F_{5/2}$ waves are presented and compared with those of other analyses. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 6733 and 7065.

6854 (COO–2271-10) MODEL CALCULATION OF CORRELATIONS AT HIGH ENERGY. Finkelstein, J. (Columbia Univ., New York). 1973. 14p. Dep. NTIS $3.00.

The inclusive two-body correlation function for particles produced in high energy hadronic collisions is calculated in a multiperipheral-like model, and compared with experiment. (auth)

6855 (COO-3001-34) EXCHANGE CURRENT EFFECTS IN $np \rightarrow d\gamma$ AND BACKWARD $ed \rightarrow enp$. Riska, D. O. (State Univ. of New York, Stony Brook. Dept. of Physics). 1972. Contract AT(11-1)-3001. 4p. Dep. NTIS $3.00.

The influence of meson exchange currents on the low-energy cross sections for $np \rightarrow d\gamma$ and $ed \rightarrow enp$ is discussed. It is shown that if the dominant exchange current processes are taken into account, the theoretical cross sections come into good agreement with the empirical data. (auth)

6856 (ITF–72-190-P) CORRECTIONS TO A DIFFRACTIONAL APPROXIMATION. Polozov, A. D. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 11p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

High energy particle scattering by the nuclei is well described in the framework of a high energy or diffractional approximation. The formulas for the matrix element of the amplitude of a particle elastic scattering by few-nucleon systems which take into account the nucleon interaction within a nucleus are obtained in a diffractional approximation on the basis of exact scattering equations. The corrections which are connected with a deviation from a geometrical optics and take into account the nucleon motion within a nucleus are calculated. Their estimate is shown. (auth)

6857 (ITF–73-37-P) CONSIDERATION OF THE INFLUENCE OF FINITENESS OF π-N INTERACTION RADIUS ON π-d SCATTERING LENGTH. Petrov, N. M.; Peresypkin, V. V. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Using formalism of the Faddeev integral equations the π-meson-deuteron scattering length is calculated. The nucleon–nucleon and pion–pion interactions are described by a potential with separable variables in the S-state. The dependence of π-meson-deuteron scattering length on the shape of nucleon–nucleon attractive potential and on the value of the pion–nucleon interaction effective radius is investigated. (auth)

6858 PION DISTRIBUTIONS IN PROTON–PROTON SEMI-INCLUSIVE REACTIONS. Wu, C. C. (California Inst. of Tech., Pasadena). AT(11-1)-68. Lett. Nuovo Cim.; 6: No. 15, 617-623 (14 Apr 1973).

The properties of the interactions $p + p \rightarrow \pi^+(\pi^-) + (n_{ch} - 1)$ charged + anything neutral are investigated in the fragmentation model. It is found that the pp (π^+, n_{ch}) and pp (π^-, n_{ch}) momentum spectra have the same shape, and that the invariant distribution satisfies the scaling law. Some consequences of these results are discussed and checked with the experimental data. (LBS)

6859 APPLICATION OF PADE APPROXIMANTS IN THE THREE-BODY PROBLEM. Tjon, J. A. (State Univ., Utrecht). pp 241-252 of Padé Approximants and Their Applications. Graves-Morris, P. R. (ed.). London; Academic Press Inc. (London) Ltd. (1973).

From conference on Padé approximants; Canterbury, UK (17 Jul 1972). See CONF-720612–.

It is stated that the three-nucleon system has been studied extensively but that in most of the calculations separable two-body interactions have been used. The application of Padé techniques to the multiple scattering series of the Faddeev equations is discussed. As an example, a system of three identical scalar bosons, interacting through two-body forces, is considered. The three-particle boundstate is considered and it is shown how the ground-state wave function can be computed. The scattering region is then discussed. A case of a Yukawa potential was taken as an example of the three-nucleon problem. (UK)

6860 PADE APPROXIMANTS IN NUCLEON–NUCLEON DYNAMICS. Turchetti, G. (Univ., Bologna). pp 313-318 of Padé Approximants and Their Applications. Graves-Morris, P. R. (ed.). London; Academic Press Inc. (London) Ltd. (1973).

From conference on Padé approximants; Canterbury, UK (17 Jul 1972). See CONF-720612–.

It is stated that in strong interactions it is often found that the second term in the perturbation expansion for the S matrix is much larger than the first one, bound states and resonances corresponding to polar singularities in the coupling constant α causing the asymptotic expansion to diverge. To extract the relevant information corresponding to the physical value of α

the perturbation series is replaced by a sequence of Padé approximants. Discussion follows, under the headings: properties of the simplest operator Padé approximant; the scalar and matrix Padé approximants. Discussing the NN interaction it is stated that it is very suitable to test the various Padé approximants previously proposed since the Lagrangian is known to some extent and the experimental situation very well defined. (UK)

6861 INCLUSIVE PROCESSES AND SHADOW EFFECTS IN DEUTERON. Kaidalov, A. B.; Kondratyuk, L. A. (Inst. for Theoretical and Experimental Physics, Moscow). Nucl. Phys.; B56: No. 1, 90-108(1973).

Using the data on inclusive spectra the contribution of inelastic intermediate states to the shadow correction Δ for high-energy ($E > 10$ GeV) hadron-deuteron scattering was analyzed. It is noted that the intermediate states with large masses $M^2 \sim ER^{-1}$ may contribute appreciably to the shadow correction, but the estimate of this contribution in the framework of the Regge-pole model for inclusive processes shows that it is small. The main contribution to the Δ is due to the small masses $M < 2$ GeV, which are produced by diffraction dissociation. The value Δ_{inel} for pd, πd and Kd scattering is estimated and the energy dependence of Δ is estimated. The results are in agreement with the existing experimental data. (auth)

Particle Invariance Principles and Symmetries

General

6862 (ITF-73-6-P) REPRESENTATIONS $(\lambda_0,C)^+$ OF THE GROUP $\widetilde{SL}(2,C)$ IN THE FOCK–BARGMAN REALIZATION. Sannikov, S. S. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 24p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.25.

Basic formula of the representations $(\lambda_0,C)^+$ of the group $\widetilde{SL}(2,C)$ in the Fock–Bargman realization are obtained. The representations $(\lambda_0,C)^+$ are used to construct the representations $(\lambda_0,O;C)$ and $(C,O;\lambda_0)$ of the group $\tilde{p}$. Under contraction $p \supset SL(2,C)(\lambda_0;O;C) = \bigoplus_{p=-\infty}^{\infty} (\lambda_0,C+p)^+$, $(C,O,\lambda_0) = \bigoplus_{q=-\infty}^{\infty} (\lambda_0+q,C)^+$ (p,q are integers). The representations $(\lambda_0,O;C)$ and (C,O,λ_0) are extended in a natural way to the representations $(\lambda_0,O,O;C)$ and $(C,O,O;\lambda_0)$ of the group $\widetilde{SU}(2,2)$. Finally, the representations $(\lambda_0,O,O;C)$ or $(C,O,O;\lambda_0)$ are used to construct the representations (λ_0,C,O,O) of the group $\widetilde{Sp}(4,R)$. Under restriction of $Sp(4,R) \supset SU(2,2)$ on the subgroup SU(2,2) one has $(\lambda_0,C,O,O) = \bigoplus_{q=-\infty}^{\infty} (\lambda_0+q,O,O;C)$; on the other subgroup one has $(\lambda_0,C,O,O) = \bigoplus_{p=-\infty}^{\infty} (C+p,O,O;\lambda_0)$. Algebra S and a representation of it in the space $\phi'_{(\lambda_0,C,O,O)} \oplus \phi'_{(\lambda_0+1/2,C+1/2,O,O)}$ are defined. (auth)

6863 (ITF-73-31-E) FOURIER TRANSFORMATION OF GROUP FUNCTIONS. [Part] I. Klimyk, A. Y. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 38p. Dep. NTIS (U. S. Sales Only) $4.00.

The formulas of direct and inverse Fourier transformations and Plancherel formula are deduced for the functions which are given on a semi-direct product of the groups satisfying some conditions. Analogs of Fourier transformations and Plancherel formula for the functions on complex semi-simple Lie group in which the way of integration over representation parameters are shifted with respect to the usual ones are given. (auth)

6864 METHOD OF NONLINEAR GROUP REPRESENTATION IN NONLINEAR SPINOR THEORY. Smirnov, A. D. (Moscow State Univ.). Izv. Vyssh. Ucheb, Zaved., Fiz.; No. 12, 49-55(1972). (In Russian).

Nonlinear spinor equations were established by a method of nonlinear group representations of symmetry. The basic field ψ was transformed according to the linear spinor representation to a Lorentz orthochronic group $L\uparrow$. A group of internal symmetry $G^{(r)}$ was realized as a group of nonlinear transformations of the field ψ. The invariant nonlinear spinor equations $G^{(r)}$ were found in terms of a covariant derivative. The group SU(2) was examined as an example. (tr-auth)

Applications (Electromagnetic and Weak)

6865 (COO-2271-9) THEORY OF SPONTANEOUS T VIOLATION. Lee, T. D. (Columbia Univ., New York). 1973. 48p. Dep. NTIS $4.50.

A theory of spontaneous T violation is presented. The total Lagrangian is assumed to be invariant under the time reversal T and a gauge transformation (e.g., the hypercharge gauge), but the physical solutions are not. In addition to the spin 1 gauge field and the known matter fields, in its simplest form the theory consists of two complex spin 0 fields. Through the spontaneous symmetry breaking mechanism of Goldstone and Higgs, the vacuum expectation values of these two spin 0 fields can be characterized by the shape of a triangle and their quantum fluctuations by its vibrational modes, just like a triangular molecule. T violations can be produced among the known particles through virtual excitations of the vibrational modes of the triangle which has a built-in T violating phase angle. Examples of both Abelian and non-Abelian gauge groups are discussed. For renormalizable theories, all spontaneously T violating effects are finite. It is found that at low energy, below the threshold of producing these vibrational quanta, T violation is always quite small. (auth)

6866 ELECTROMAGNETIC INTERACTION IN SU(3) × SU(3) SYMMETRY AND PSEUDOSCALAR MESON DECAYS. Zupnik, B. M.; Ivanov, E. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 3, 582-591(Mar 1973). (In Russian).

The critical analysis of the well known difficulties in the SU(3) × SU(3)-current algebra description of the electromagnetic processes of the second order in e is carried out by the effective Lagrangian method. The electromagnetic mass shift in the pseudoscalar octet and also the decays $\eta \to 3\pi$, $\pi^0 \to \gamma\gamma$, $\eta \to \gamma\gamma$, $\eta' \to YY$ are considered. Contrary to widespread opinion, these processes shown can be described indiscrepantly on the basis of the electromagnetic interaction with conventional transformation properties under the group SU(3) × SU(3). (auth)

6867 NONLOCALITY AND UNITARY TRANSFORMATION IN CP-VIOLATING KAON DECAY. Kim, D. Y. (Univ. of Saskatchewan, Regina). Lett. Nuovo Cim.; 6: No. 14, 573-576(7 Apr 1973).

A possible new formulation of CP violation in neutral-kaon decay is discussed. It is found that a suitable unitary transformation of the long-lived kaon state $|K_2\rangle$ leads to the observed long-lived kaon state $|K_L\rangle$: $|K_L\rangle = U(a)|K_2\rangle$. Similarly, a transformation is obtained for the short-lived kaon state $|K_S\rangle = U(a)|K_1\rangle$. The unitary operator $U(a) = \exp[ia \cdot p]$ is an infinitesimal translation operator. (LBS)

Applications (Strong)

6868 (IC-73/28) ON SL(6,C) GAUGE INVARIANCE. Salam, A. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1973. 21p. (CONF-730124-1). Dep. NTIS (U. S. Sales Only) $3.25.

The Einstein-Cartan-Weyl theory of spin 2^+ particles is reviewed, and its SL(2,C) gauge-invariant character brought out. The theory generalizes the description of nonets of 2^+ and 2^- particles when SL(2,C) invariance is extended to spin and unitary-spin-containing group SL(6,C) × SL(6,C). The conserved currents which close on the algebra of SL(6,C) × SL(6,C) are the sources of a spin-unitary-spin-torsional tensor which generalizes Cartan's tensor of spin-torsion. (auth)

6869 NONLINEAR THEORY OF NEUTRAL KAONS. Shapiro, I. S. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 17: No. 4, 852-861(Apr 1973). (In Russian).

The transformation of the nonlinear equation for the state vector for time reversal and combined inversion is considered. It is shown that in the theory without superposition the admixture of K_1 (K_2) in K_L (K_S) may be small if the constants of CP invariant and noninvariant weak interactions are equal. (auth)

Scattering Theory

Refer also to abstracts 6859 and 7220.

6870 (COO-2271-11) SOME FUNCTIONAL INEQUALITIES, WITH APPLICATION TO GREENS' FUNCTIONS. Luttinger, J. M.; Friedberg, R. (Columbia Univ., New York; Barnard Coll., New York). [nd]. 18p. Dep. NTIS $3.00.

Some elementary inequalities for functionals with functional derivatives of given sign are presented and proved. These are then applied to the study of Greens' functions for diffusion processes in a medium with sources and sinks (or alternately Schrödinger operator Greens' functions). The resulting inequalities are shown to include as quite special cases the super- and sub-additive inequalities of potential theory. One consequence of the generalization is that the scattering length is also shown to have sub-additive properties. (auth)

6871 (ITF-72-156-E) CONSTRUCTION OF THE BOGOLIUBOV SCATTERING OPERATOR IN THE $(P^{2m}(\varphi))_2$ THEORY. Semenov, Yu. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

The Bogoliubov scattering operator S(g) is constructed for the $(P^{2m}(\varphi))$ theory with a factorized test function g. Unitarity and causality are verified for this S(g). Some problems of the existence of solutions for the evolution equation are discussed. (auth)

6872 (ITF-72-173-E) SOME TOPOLOGICAL PROPERTIES OF LANDAU CURVES. Enolsky, V. Z. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 36p. Dep. NTIS (U. S. Sales Only) $4.00.

The convexity of components of the Landau curves corresponding to the nonnegative values of Feynman parameters is studied. It is shown that one can draw a conclusion on the downward or upward convexity of the Landau curve if one knows the critical point indices of the Feynman denominator and of some function, connected to it; besides, with sufficiently large equal internal masses as compared to the external masses, the Landau curve components do not contain singular points. Also the sufficient conditions of existence of the Mandelstam representation are given. (auth)

6873 (JEN-256) REVIEW OF THE HELICITY FORMALISM. Barreiro, F.; Cerrada, M.; Fernandez, E. (Junta de Energia Nuclear, Madrid (Spain)). 1972. 77p. (In Spanish). Dep. NTIS (U. S. Sales Only) $6.00.

A brief and general review of the helicity formalism is presented. Lorentz invariance, spin, and helicity ideas are discussed in section 1. Section 2 deals with the construction of relativistic states and scattering amplitudes in the helicity basis and studies their transformation properties under discrete symmetries. Finally some more sophisticated topics like kinematical singularities of helicity amplitudes, kinematical constraints, and crossing relations are presented. (auth)

6874 (JINR-P2-7029) APPROXIMATE SOLUTIONS IN THE $h^2/4\ \phi^4$ MODEL AND EQUATIONS ON TRAJECTORIES FOR THE GREEN FUNCTIONS. Barbashov, B. M.; Nesterenko, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 27p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

By introducing an auxiliary field A(x), the solution of the model with $L_{int}\ (h^2/4)\ \phi^4$ is reduced to finding of the solution in $L_{int} = h\phi^2 A$ theory and further functional averaging over the A(x) field, having propagator $D_A(x-y) = \frac{1}{2}\delta(x-y)$. An approximate solution for the one-particle Green function and high-energy behavior of the elastic scattering amplitude are studied. (auth)

6875 STATES WITH LOW ENERGY IN A SYSTEM OF TWO PARTICLES IN A FIELD. Dyugaev, A. M. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 17: No. 3, 634-642(Mar 1973). (In Russian).

Properties of the system, consisting of two particles, which are in the potential field are being studied. The case when interaction of each of the particles with the field is of resonance character and all pair forces are short-range ones is considered. The system spectrum is found and it is clarified how the presence of resonance in single-particle problem influences elastic and inelastic scattering. (auth)

6876 LARGE ANGLE SCATTERING IN DAMA MODEL. Bugrii, A. I.; Enkovskii, L. L.; Kobylinskii, N. A. (Inst. of Theoretical Physics, Kiev). Yadern. Fiz.; 17: No. 3, 614-620 (Mar 1973). (In Russian).

The behavior of a dual amplitude with Mandelstam analyticity (DAMA) at high energies and fixed nonzero scattering angles is studied. It is shown that alongside the Regge behavior at fixed momenta transfers the amplitude exhibits correct dependence on s and t at fixed scattering angles, which agrees with experiment and rigorous bounds in analytic theory of the S-matrix. (auth)

6877 METHOD FOR THE ANALYTIC CONTINUATION OF THE S-MATRIX FOR CUT-OFF POTENTIALS. Minelli, T. A.; Vitturi, A.; Zardi, F. (Univ., Padua). Nuovo Cim.; 14A: No. 4, 827-849(21 Apr 1973).

The l-th partial-wave S-matrix element for cut-off potentials is Taylor-expanded in the energy and momentum variables. The expansion is based on a suitable finite-interval Green's function, by which the derivatives are obtained in a recursion form involving only repeated integrations of the Green's function itself. The Taylor series can be analytically continued by resorting to the Padé method; some results of a numerical experiment are quoted. In this paper, however, the emphasis is put on a rather indirect but rigorous procedure based on the Hadamard theory, which allows, in principle, all the poles of the S-matrix starting from its momentum Taylor series to be determined. Numerical results are displayed. (auth)

6878 ORIGIN OF UNITARITY AND DUALITY IN THE NAKANISHI AMPLITUDE. Misra, R. C. (Univ. of Nigeria, Nsukka); Ross, W. R. Lett. Nuovo Cim,; 6: No. 17, 704-706 (28 Apr 1973).

In a previous study of dual amplitudes with Mandelstam analyticity, it was shown that the Nakanishi scattering amplitude is a very successful model when crossing, Regge behavior, Mandelstam analyticity, and duality in a generalized sense are concerned. The origin of unitarity in the Nakanishi scattering amplitude is pointed out and it is shown that the Nakanishi scattering amplitude can be expanded in continuous Veneziano terms. (LBS)

6879 EXISTENCE AND COMPLETENESS OF THE WAVE OPERATORS FOR SPHERICALLY SYMMETRIC POTENTIALS. Pearson, D. B.; Whould, D. H. (Univ. of Hull, Eng.). Nuovo Cim.; 14A: No. 4, 765-780(21 Apr 1973).

The existence and completeness of the wave operators are proved for scattering by a large class of local, spherically symmetric potentials. (auth)

6880 MONOTONOUS DEPENDENCE OF K-MATRIX ON POTENTIAL IN KOHN VARIATIONAL METHOD. Peterkop, R. K. (Inst. of Physics, Riga). Yadern. Fiz.; 17: No. 4, 877-881(Apr 1973). (In Russian).

It is shown that for approximate solutions of the many-channel problem by the Kohn variational method the monotonous dependence is preserved, i.e., positively (negatively) defined variation in the potential matrix results in negatively (positively) defined variation in the K-matrix. The application of the monotonous property to account of closed channels is discussed. (auth)

6881 SOME REMARKS ON POTENTIAL SCATTERING. Palombo, F.; Pelosi, V. (Univ., Milan). Lett. Nuovo Cim.; 7: No. 1, 33-34(5 May 1973).

Comments are made on the generation of partial-wave amplitudes for elastic scattering of strongly-interacting particles by some potential in a wave equation when inelastic processes are present. It is suggested that in order to take into account inelastic channels the potential should contain an imaginary component which should be bounded as to satisfy the proper limit. It is also suggested that the imaginary part of logarithmic derivative of the inner wave function at the matching point should be a positive quantity. (LBS)

6882 PADE APPROXIMANTS IN POTENTIAL SCATTERING. Garibotti, C. R. (Univ., Bari, Italy). pp 253-270 of Padé Approximants and Their Applications. Graves-Morris, P. R. (ed.). London; Academic Press Inc. (London) Ltd. (1973).

From conference on Padé approximants; Canterbury, UK (17 Jul 1972). See CONF-720612-.

It is stated that two body potential scattering is a testing ground for approximation methods intended to be useful in relativistic or in three body theories. The solution of the Lippmann-Schwinger equation in a finite subspace, and its relation with the Padé approximation, is discussed. The results for the scattering amplitude follow from this relation. A report is given on the known results about unitarity of the Padé approximation and the convergence of the denominator of the [N,N] approximant to the Jost function. This is followed by a discussion of the approach used to calculate the binding energies with the Padé approximant. The subject is dealt with in sections headed: the wave function, the scattering amplitude, bound states, Rayleigh-Schrödinger expansion, analytical continuation in the k-plane. (UK)

6883 UNITARITY CONSTRAINTS ON A MODEL FOR MULTIPARTICLE PRODUCTION. Nulman, R.; Predazzi, E. (Univ., Turin). Nuovo Cim.; 15A: No. 2, 227-243(21 May 1973).

The full two-body unitarity condition is applied to provide compatibility requirements constraining, in the high-energy, small-angle region, the parameters of a specific multiparticle production model. This model is very crude and over-simplified but the main purpose of the paper is to show the viability of a program in which the complete system of unitarity equations should be used in order to determine the form of the amplitude. (auth)

6884 HARD REGGE CUTS CONSISTENT WITH ELASTIC UNITARITY. Branson, D. (Univ. of Essex, Colchester, Eng.). Nuovo Cim.; 15A: No. 2, 217-226(21 May 1973).

It is shown that a Regge cut whose discontinuity is non-zero at its end-point may be consistent with elastic unitarity in three situations: a) at isolated points where a pole and soft cut coincide; b) if there is more than one cut, allowing a soft cut to exchange positions with a hard cut in the j-plane as t is taken around threshold; c) if there is a shielding cut which coincides with the hard cut in the j-plane as t reaches threshold. Examples of each mechanism are given. (auth)

6885 ASYMPTOTIC UPPER BOUND ON THE 3-TO-3 AMPLITUDE. Patrascioiu, A. (Massachusetts Inst. of Tech., Cambridge). Nuovo Cim.; 15A: No. 2, 249-273(21 May 1973).

Unitarity and analyticity are used in the context of the multi-Regge hypothesis to imply an asymptotic upper bound on the 3-to-3 amplitude in the helicity-pole–Regge-pole limit. The derivation parallels the one used by Froissart for the 2-to-2 amplitude, but the presence of physical-region singularities and integral inequalities complicates the present case and makes the result rather heuristic. (auth)

6886 ZEROS OF THE TRIPLE REGGE VERTEX. Patrascioiu, A. (Massachusetts Inst. of Tech., Cambridge). Nuovo Cim.; 15A: No. 2, 274-280(21 May 1973).

The triple Regge vertex, which appears in the helicity-pole–Regge-pole (HPRP) limit of 1-particle inclusive cross sections, is shown to have certain zeros. The proof uses the upper bound imposed by unitarity and analyticity on the 3-to-3 amplitude in the HPRP limit. (auth)

6887 THREE-BODY PROBLEM: A FORMALISM AND COMPUTER CODE FOR ARBITRARY KINDS OF PARTICLES. Larson, N. M. East Lansing, MI; Michigan State Univ. (1972). 190p. University Microfilms Order No. 73-12,759.

Thesis (Ph. D.).

The main emphasis of the work reported was to develop a formalism and computer code to apply the Faddeev–Lovelace equations to describe the interaction of three arbitrary particles. The particles may have any spin, isospin, and mass. It is assumed that the two-body interactions can be expressed as sums of separable potentials. Tensor forces and hard cores are allowed. The formalism treats the general case, rather than one specific three-body problem. Care is taken to ensure that all expressions are presented in a form which could be readily programed. This has allowed one to produce a computer code which maintains a significant portion of the generality of the formalism. The usual method of solving the integral equation for the three-body T-matrix involves deforming the contour of integration off the real axis into the complex plane. This method has the serious disadvantage of requiring major modifications in the computer code whenever a different three-body system is to be studied. Therefore in order to produce a more widely applicable code, one has abandoned the contour-deformation method and instead attack directly the original problem of treating the singularities on the real axis. Explicit account of the pole, square-root, and logarithmic singularities that occur there is taken. It is shown that the solution of the integral equation has certain analytic properties which allow it to be approximated by a discrete set of values, multiplied by interpolating functions. By integrating the singular kernel with these interpolating functions, one can find a matrix kernel appropriate for determining the approximate solution of the original equation. Therefore the problems of integrating over the singularities of the kernel appear only in the determination of the elements of the matrix kernel. By choosing this approach one can construct one computer code which is capable of handling many different three-body calculations. For each specific calculation, the investigator must program only those small portions of the code which provide information on the two-body interactions and on the exact form of the mesh which he is using. All the difficulties associated with the three-body aspects of the calculation have been built directly into our computer code; the user need not understand the inner workings of the code in order to use it profitably. This code is now in operational form. It was shown to produce results as accurate as those found using the contour-deformation method. (Diss. Abstr. Int., B)

6888 CONCENTRATABLE FUNCTIONALS AND ASYMPTOTIC RELATIONS FOR SCATTERING AMPLITUDES. Lomsadze, Yu. M.; Sabad, E. P. (Inst. of Theoretical Physics, Uzhgorod, USSR). Nucl. Phys.; B56: No. 1, 145-172(1973).

Very wide classes of concentratable functionals are considered, i.e., classes where the notion of concentrating, which satisfies a certain six axioms, can be introduced, and where it is possible to formulate the microcausality (or the local-commutativity) principle as the requirement of concentration of functionals in the corresponding space–time region. Every such class of functionals is essentially wider than the class of tempered distributions and is defined on some analytic functions only. It is proved that the asymptotic smoothed partially-microcausal amplitude of an arbitrary reaction, under corresponding conditions imposed only in the physical region of changing arguments, satisfies all the asymptotic relations. (auth)

6889 UNITARITY OF THE WICK T-EXPONENT. Vasil'ev, A. N.; Pis'mak, Yu. M. (Leningrad State Univ.). Teor. Mat. Fiz.; 15: No. 2, 182-196(May 1973). (In Russian).

The proof of unitarity of the regularized S-matrix written in the form of the Wick T-exponent is given, which preserves its validity also for interactions including derivatives. The combinatorial part of the proof is performed in terms of the functional integration language. At first, the formal unitarity of the non-regularized S-matrix is proved; then the regularization of the Pauli–Villars type is introduced (for such a regularization Wick's and Dyson's definitions of the operator T-product coincide with each other [1]) and the unitarity of the regularized S-matrix is demonstrated in every order of the perturbation theory. (auth)

6890 RENORMALIZED SCATTERING THEORY FOR THE YUKAWA MODEL. II. Wave Operators. Aref'eva, I. Ya. (Inst. of Mathematics, Leningrad). Teor. Mat. Fiz.; 15: No. 2, 207-220(May 1973). (In Russian).

For the Yukawa model with the aid of the dressing operator $T_0(g, \sigma)$ the space $\mathcal{H}_{ren}$, different from the Fock space, is constructed, in which the renormalized Hamiltonian $H_{ren}(1, \sigma)$ with the space cut-off removed is a self-adjoint operator. The existence of renormalized operators is proved for the pair of operators H_0 and $\overline{H}_{ren}(1, \sigma)$. (auth)

6891 ANALYTIC EXTRAPOLATION OF SCATTERING AMPLITUDES IN L^2 NORM. Sabba-Stefanescu, I. (Inst. for Atomic Physics, Bucharest). Nucl. Phys.; B56: No. 1, 287-300(1973).

The problem of the analytic extrapolation of scattering amplitudes to interior points from a least-squares error channel is studied and found to be stable if some L^2 norm of the amplitude on the remainder of the cuts obeys a certain bound. The minimal possible value of this bound is of relevance to a model-independent location of the various singularities of scattering amplitudes. A simple and rigorous method is given for its construction and the numerical results of a singularity search are presented. The method is shown to be capable of accommodating unequal errors on the real and imaginary parts of the amplitude and is applicable to both simply and doubly connected domains (energy and cosine extrapolations). (auth)

6892 BEHAVIOR OF THE PHASE SHIFT NEAR THE RESONANCE. Arsen'ev, A. A. (Moscow State Univ.). Teor. Mat. Fiz.; 15: No. 2, 259-265(May 1973). (In Russian).

The behavior of the phase shift near the resonant value of the energy is considered. (auth)

6893 ADLER PRINCIPLE AND ALGEBRAIC DUALITY. Volkov, D. V.; Gershun, V. D.; Zheltukhin, A. A.; Pashnev, A. I. (Physical-Technical Inst., Kazan). Teor. Mat. Fiz.; 15: No. 2, 245-258(May 1973). (In Russian).

The Adler principle and the algebraic duality condition are discussed for separate terms in the expansion of the n-point dual amplitude over uniform functions of orders $r = 1, 2, \ldots$ of kinematical invariants S_{ik}. The Adler principle is satisfied due to using of the phenomenological Lagrangian invariant under the symmetry group under consideration and including an arbitrary number of derivatives of meson fields. It is shown that the algebraic duality condition leads to the more or less strong restrictions depending on the structure of the symmetry group. (auth)

6894 SOLUTION OF THE TIME DEPENDENT SCHROEDINGER EQUATION AT A GIVEN POTENTIAL. Istatkov, Ts.; Khristov, Kh. Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk.; 22: 137-156(1972). (In Russian).

The solution of the time-dependent Schroedinger equation in the case of two particles interacting by a spherical potential barrier. The initial state by $t = 0$ is given as plane wave in the space of the coordinates of the considered particles. The solution is obtained in the form of an expansion on the Legendre polynomials of the cosine of the scattering angle and the coefficients are found as simple integrals of given expressions elementary and Bessel functions. In principle the problem is not a complicated one, but the solution is given in a definite and quite simple form. It gives the possibility to evaluate the asymptotics by large values of the time that is necessary for other purposes. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

6895 NEW MECHANISM OF DISSIPATION IN THE ACCELERATED FLOW OF SUPERFLUID HELIUM. Calvani, P.; Greulich, R.; Maraviglia, B. (Univ., Rome). Lett. Nuovo Cim.; 6: No. 13, 536-540(31 Mar 1973).

A new model is presented which shows that any accelerated isothermal flow of liquid helium is dissipative and which explains both the absolute value and the temperature dependence of the oscillations damping without using any experimental parameters. (MHR)

6896 STABILIZER FOR STABILIZING THE TEMPERATURE OF SUPERFLUID HELIUM NEAR THE LAMBDA-POINT. Khirnyi, V. F.; Malyshev, E. N. (Physical-Technical Inst., Donetsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1574-1576 (1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 239-242(1972).

An electronic stabilizer for stabilizing the temperature of superfluid helium near the temperature of the λ-point with a capacity of pickup is described. The pickup uses the strong temperature dependence of the permittivity of superfluid helium near the phase-transition temperature for $T_\lambda - T \leq 10^{-3}$ °K[1]; in practice a stabilization was achieved which is no worse than $\pm 5 \cdot 10^{-5}$ °K. The low heat evolution in the temperature pickup proper eliminates the necessity of extrapolating the readings of the pickup to zero power. (auth)

6897 TEMPERATURE DERIVATIVE OF THE PRESSURE OF ^{4}He AT THE SUPERFLUID TRANSITION. Ahlers, G. (Bell Telephone Labs., Murray Hill, NJ). J. Low Temp. Phys.; 7: No. 3-4, 361-365(May 1972).

New measurements of the temperature derivative of the pressure along the superfluid transition line in ^{4}He near saturated vapor pressure are presented. These results indicate that the second derivative $(\partial^2 P/\partial P \partial T)_\lambda$ is finite at saturated vapor pressure. The data agree with earlier measurements by Kierstead. (auth)

6898 MICROSCOPIC THEORY OF IMPURITIES IN LIQUID HELIUM. I. Bowley, R. M. (Cavendish Lab., Cambridge, Eng.). J. Low Temp. Phys.; 7: No. 3-4, 185-199(May 1972).

Impurities in liquid He II are shown to be closely analogous to polarons in the continuum model. There is an extra term in the Hamiltonian of the system arising from the interaction between the phonons. By renormalizing the phonons a term is obtained in the Hamiltonian describing the scattering of the renormalized phonons of the impurity. A few results of polaron theory are used to discuss ^{3}He impurities and electrons in liquid helium II. (auth)

6899 EVIDENCE FOR THE HYDRODYNAMIC ORIGIN OF CRITICAL HEAT CURRENTS IN HELIUM II. Oberly, C. E.; Tough, J. T. (Ohio State Univ., Columbus). J. Low Temp. Phys.; 7: No. 3-4, 223-228(May 1972).

It is found that the critical heat current measured in a modulated heat flow in superfluid He II is substantially larger than in a steady flow. The variation of critical heat current with the modulation frequency and amplitude is shown to be analogous to the enhancement of stability observed in the flow of conventional fluids. (auth)

6900 MICROSCOPIC DERIVATION OF THE TWO-FLUID THERMOHYDRODYNAMIC EQUATIONS FOR ^{4}He II. Hyland, G. J.; Rowlands, G. (Univ. of Warwick, Coventry, Eng.). J. Low Temp. Phys.; 7: No. 3-4, 271-289(May 1972).

The equivalence of the set of hydrodynamic equations for the macroscopic quantities associated with the ^{4}He II condensate and noncondensate — the natural parameters which occur in an O.D.L.R.O.-based microscopic theory — to the phenomenological equations for the super and normal fluids of the thermodynamic two-fluid model is uniquely established. This is achieved by defining the velocity of the normal fluid operationally as the velocity of entropy transport, from which follows a relationship between the condensate and superfluid densities. Consideration of boundary conditions together with this relation between the condensate and superfluid densities shows that the presence of the condensate allows the rest (majority) of the fluid to "slip" relative to a stationary boundary. The amount of slip is temperature dependent and, in particular, at absolute zero total slip occurs, i.e., the whole system is superfluid. Finally, the density relation is used to estimate the temperature dependence of the condensate density, and it is suggested that the dramatic change at about 0.5 K, predicted on the basis of this relation, be investigated via measurement of the temperature dependence of the liquid structure factor. (auth)

6901 DYNAMICAL SIMILARITY AND TURBULENCE OF LIQUID HELIUM II IN A ROTATING-CYLINDER VISCOMETER. Devaraj, N.; Hollis Hallet, A. C. (Univ. of Toronto). J. Low Temp. Phys.; 7: No. 3-4, 211-222(May 1972).

A rotating-cylinder, Couette-type viscometer was built to study particularly the higher velocity regions where previous experiments had indicated a flow pattern that differed from laminar Couette flow. It was of the same type as previous viscometers having an outer cylinder that was rotated at various steady angular velocities, while the inner cylinder was suspended by a torsion fiber, but was much smaller. At low velocities $v < v_c$ Couette flow was found and the viscosity values deduced compared well with previous measurements. At much higher velocities in excess of another "critical" velocity v_t the results indicated turbulent flow between the cylinders; this region began at a Reynolds number of about 3000 both in He II and in carbon disulphide. For $v_c < v < v_t$ dynamical similarity of the results in He II with those in classical liquids is not at all exact; additional effects are present in the He II results that must be ascribed to its particular properties. (auth)

6902 THEORY OF THE CREEPING FILM PHENOMENON IN LIQUID ^{4}He. Khanna, K. M.; Das, B. K. (Dibrugarh Univ., India). Indian J. Pure Appl. Phys.; 10: No. 11, 765-767(Nov 1972).

The hydrodynamical equations proposed by C. C. Lin [Phys. Rev. Lett., 2(1959), 245; On the hydrodynamics of liquid helium-II: Part I — Perfect fluid theory (Pre-print, Institute for Advanced Study, Princeton), 1960] were solved under certain boundary conditions. The solution leads to a theoretical explanation of the experimentally observed phenomenon of the creep of liquid He-II up the walls of the container. (auth)

Superconductivity

Refer also to abstracts 6309 and 6341.

6903 (AD-751911) HIGH FREQUENCY RESPONSE OF JOSEPHSON POINT CONTACTS. Report for June 1970—June 1972. Kanter, H.; Vernon, F. L. Jr. (Aerospace Corp., El Segundo, Calif.). 1 Oct 1972. Contract F04701-72-C-0073. 51p. (SAMSO-TR-72-243). NTIS.

For a current driven Josephson junction shunted by an ohmic resistance, the dc voltage response and impedance to external high frequency currents are calculated with a second order perturbation method based on the unperturbed solution for the time evaluation of the voltage as given by Aslamazov and Larkin. The response is proportional to signal power and has three characteristic frequency regions depending on whether the internal, self-generated Josephson frequency is larger than, equal to, or smaller than the signal frequency. (auth) (NTIS)

6904 (RLO-2225-T-13-14) STUDY OF PHASE TRANSFORMATIONS AND SUPERCONDUCTIVITY. Annual Progress Report. Polonis, D. H. (Washington Univ., Seattle. Coll. of Engineering). 15 Oct 1972. Contract AT(45-1)-2225. 58p. Dep. NTIS.

The experimental work of the past year has continued to focus on the control of alloy constitution and microstructure as a means of developing enhanced superconducting properties and high mechanical strength in alloys. Both phases of the program have concentrated on several specific aspects of beta phase decomposition in Ti and Zr alloys including the formation and reversion of the omega phase, phase separation processes, and alpha phase precipitation. Modifications in alloy structure involving each of these phenomena have a profound effect on the superconducting behavior and the mechanical properties. The investigation of transformation processes in beta stabilized titanium and zirconium alloys has revealed the following important results: a) Fine precipitates that do not lead to diffraction effects have been detected in quenched Ti-Cr alloys quenched to retain 100% beta phase. b) During the initial stages of aging, the fine precipitates tend to grow and produce strain in the beta matrix prior to the detection of the omega phase. c) A phase separation reaction can enhance or retard the nucleation of the omega phase, depending on the temperature at which the phase separation is induced. d) When the omega phase is reprecipitated after step quenching or a reversion treatment, it nucleates randomly in the enriched beta matrix without any apparent association with the solute lean zones. e) The nucleation of the alpha phase occurs preferentially at the interface between solute lean and solute rich regions. Superconducting transition measurements performed on several series of quenched titanium ternary alloys have verified that there is a dependency of Tc on the electron-atom concentration (e/a). It has been established for alloys of the Ti–Mo–Nb system that increasing the ratio of Mo : Nb decreases the maximum value of Tc from 9.8°K for the Ti–Nb binary system to 4.1°K for the Ti–Mo binary system. Experiments on ternary Ti–Bn–Al alloys indicate that aluminum additions in excess of 5% stabilize the beta phase with respect to omega phase formation, and preliminary experiments indicate that variations in Tc can be achieved by controlling the precipitation of the alpha phase, either by slow cooling or by long time aging above 500°C. The magnetization studies of the past year have revealed a definite correlation between microstructure and the magnetization behavior of beta stabilized alloys in the superconducting state. It has been confirmed that the omega phase contributes to the flux pinning characteristics of a given alloy, and it has been shown that these characteristics are sensitive to the omega particle size and distribution. Magnetic instability has been detected at discrete values of an externally imposed magnetic field that is applied in the persistent mode. These instabilities are reproducible and are independent of magnetic history. They can be eliminated by appropriate heat treatments that revert the structure of the omega phase while retaining composition fluctuations. The initial experiments on alloys deformed in the beta condition revealed some enhancement of the stability of the superconducting state in the presence of imposed magnetic fields. (auth)

6905 MICROMAGNETIC THEORY OF FERROMAGNETIC SUPERCONDUCTORS. Krey, U. (Univ., Hamburg). Int. J. Magn.; 3: No. 1-3, 65-73(Sep 1972).

A phenomenological theory, which combines and generalizes the Ginzburg–Landau theory and the micromagnetic theory of ferromagnetism, is developed for ferromagnetic superconductors. The thermodynamic potential is written down as a function of the order parameter ψ, direction and magnitude of the local magnetic polarization J, and of the vector potential of the magnetic induction B. The theory is applied to the following problems: (1) isolated flux lines in superconducting ferromagnets, and (2) possible magnetic domain structures for vanishing external magnetic field. If the correlation length corresponding to the longitudinal magnetic susceptibility is comparable with the penetration depth λ of the magnetic induction, the flux line profiles become damped-oscillatory functions of the radius vector, and their interaction is attractive. For vanishing external field, a magnetic domain structure with domain diameters as small as 2λ or less can be stable in superconducting ferromagnets, as long as the domain wall width is much smaller than λ. 5 figures, 19 references. (auth)

6906 CRYSTAL CHEMICAL ASPECTS OF $A_3B(\beta$-W)-TYPE COMPOUNDS. Wang, F. E. (Naval Ordnance Lab., White Oak, MD). J. Solid State Chem.; 6: No. 3, 365-369(Mar 1973).

All the known A_3B compounds with the A15(B-W) type structure have been compiled. The compilation shows that the formation of the A_3B compounds to be strongly dependent on atomic orbitals of both the A and B elements. Specifically, A elements come exclusively from the transition atoms of 4-A, 5-A, and 6-A groups, whereas B elements come exclusively from 8-A, 9-A, 10-A groups of transition atoms as well as from 1-B, 2-B, 3-B, 4-B, and 5-B groups of nontransition atoms. Roughly, there is a one-to-one correspondence between the population (therefore the stability) of the A_3B compounds and their superconducting critical temperature; the more stable is the compound, the higher is the critical temperature. (3 tables, 101 references) (auth)

6907 SUPERCONDUCTIVITY OF BERYLLIUM ALLOYS. Alekseevskii, N. E.; Zakosarenko, V. M. (Inst. of Physical Problem, Moscow). Dokl. Akad. Nauk SSSR; 208: No. 2, 303-306 (11 Jan 1973). (In Russian).

Alloys of Be with Ru, Rh, Pd, Os, Ir, Pt, Ga, Cu, Ag, Mg, Ca, Al, Sc, Y, Ce, Th, U, Ge, Ti, Zr, Hf, S, Cr, Mo, W, Mn, Re, Fe, and Co were prepared by heating the mixed and compacted powders in a high-frequency furnace in a He atmosphere. Measurements were made of the critical temperature of the alloy samples and the dependence of their magnetic moment on the magnetic field. Superconductivity was noted in the Be–Ga alloys, the maximum T_c corresponding to the composition Be_3Ga. Other alloys possessing superconductive properties were: Be_5Pt, Be_5Ir, Be_5Os, and $Be_{13}Ru$. Not one compound having the $MgZn_2$ type structure (Hexagonal Laves phase) was characterized by a superconducting state at $T \lesssim 1.5$°K. The compound Be_5Pt, with a $MgCu_2$ type structure (cubic Laves phase) passed into a superconducting state at 2.3°K. (KSW)

6908 VERY SIMPLE EXPLANATION OF THE EFFECTS OF AC FIELDS ON THE CRITICAL CURRENTS IN TYPE II SUPERCONDUCTORS. Delrieu, J. M. (CEN de Saclay, Gif-sur-Yvette, France). Solid State Commun.; 12: No. 9, 881-884(1 May 1973).

The electric field induced in a type-II superconductor foil by an ac magnetic field is rectified by the non-linear static voltage current characteristic of the superconductor when there is a static current, so that the static critical current seems to decrease. (auth)

6909 SUPERCONDUCTING PROPERTIES OF ZnCr AND ZnMn ALLOYS. Vaccrone, R.; Morozzo della Rocca, A.; Pilot, A.; Vivaldi, F.; Rizzuto, C. (Univ., Genoa). Solid State Commun.; 12: No. 9, 885-889(1 May 1973).

Measurements on the superconducting critical temperature T_c and critical field, H_c, of ZnCr and ZnMn alloys, down to 0.037°K are presented. The variation of T_c with increasing concentration of impurity depends strongly on T_{cp}/θ, where T_{cp} is the pure metal's T_c and θ a characteristic temperature given by susceptibility (θ_χ) and resistivity (θ_R) measurements. θ_χ is the concentration independent Curie-Weiss temperature and θ_R the characteristic temperature of the T^2 dependence of the impurity resistivity observed in many of these systems below $\sim\theta/10$. In most cases has been found $\theta_\chi \cong \theta_R$. Effects of H_c are similar to previously studied alloys. (auth)

6910 NMR MEASUREMENTS OF THE SPEED OF VORTICES IN FLUX FLOW IN A TYPE II SUPERCONDUCTOR. Delrieu, J. M. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys., F (London); 3: No. 4, 893-906(Apr 1973).

The vortex motion in a type-II superconductor narrows the inhomogeneous static NMR lineshape. This method gives a new way to study the flux flow of vortices in type-II superconductors. In principle in a single crystal it can give a measure of the value and direction of the vortex speed. The NMR lineshape in the non-linear flux creep region is discussed. (auth)

6911 PENETRATION DEPTH AND RELATED PROPERTIES OF Al FILMS WITH ENHANCED SUPERCONDUCTIVITY. Hauser, J. J. (Bell Telephone Labs., Murray Hill, NJ). J. Low Temp. Phys.; 7: No. 3-4, 335-349(May 1972).

Using combined resistivity, susceptibility, critical field, and NMR measurements it was found that Al films with enhanced superconductivity can be divided into two separate categories depending on their residual resistivities ρ_0. Films with resistivities smaller than $\simeq 10^{-3}$ Ω·cm are metallic ($\rho_{(300K)}/\rho_0$ is larger than but very close to unity); the experimentally measured penetration depth, the upper critical field $H_\perp$, and the penetration field H_P are in good agreement with theoretically calculated values using an experimental value of the mean free path l_{eff}. The density of states for such films as inferred from NMR measurements is very close to that of bulk. On the other hand, films with ρ_0 larger than $\simeq 10^{-3}$ Ω·cm have a semiconducting behavior ($\rho_{300K}/\rho_0 \leq 1$) and are grossly inhomogeneous. The experimental values of $H_\perp$ no longer agree with the theoretical estimates using l_{eff}. In such films p_0 is no longer a meaningful parameter that can be related to l_{eff}, for it is to a large extent a tunneling resistivity as shown by the fact that films not superconducting down to 0.95 K, when measured resistively, are superconducting at 1.2 K, as shown by a susceptibility measurement. These experiments seem to indicate that in a homogeneous film l_{eff} has a lower limit of approximately 1 Å. (auth)

6912 SUPERCONDUCTIVITY IN THE TiO AND NbO SYSTEMS. Hulm, J. K. (Westinghouse Research Labs., Pittsburgh); Jones, C. K.; Hein, R. A.; Gibson, J. W. J. Low Temp. Phys.; 7: No. 3-4, 291-307(May 1972).

Electrical resistivity and superconductivity studies are presented for the Bl(NaCl) structure oxides of titanium, vanadium, and niobium. In samples of nominal composition TiO_x, VO_x, and NbO_x, x was varied from 0.8 to 1.2. It was found that all three of these oxides exhibit room-temperature electrical resistivities characteristic of metallic behavior. With decreasing temperature, the resistivity drops steeply in the case of NbO_x, but remains steady or rises somewhat in the case of TiO_x and VO_x, depending on the exact value of x. It is suggested that in TiO_x, and VO_x there is a large resistivity component due to scattering of carriers by disordered vacancies. Superconductivity was observed in NbO_x (T_c = 1.38 K, x = 1.0) and TiO_x(T_c = 1.0 K, x = 1.07). In the latter case the material showed a well-defined maximum of T_c as a function of composition, with $T_c < 0.05$ K for $x < 0.85$ and $x > 1.20$. Several VO_x samples remained normal to 0.07 K. (auth)

6913 SUBMILLIMETER AND INFRARED DETECTOR FOR THE HEATING OF SUPERCONDUCTOR ELECTRONS. Belyantsev, A. M.; Klishin, E. V. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 3, 479-481(1973). (In Russian).

The possibility of recording changes in the electromagnetic properties of a superconductor are discussed, the changes having resulted from the absorption of a weak signal. The surface impedance of the superconductor is altered upon raising the electron temperature by means of the high-frequency signal. These changes may be recorded at low frequencies, and the sensitivity of the proposed detector would be fixed by the thermodynamic fluctuations of the electron temperature in the superconductor. (KSW)

6914 DEMONSTRATION OF THE PINNING OF RIGID AND ELASTIC FLUXON LATTICES BY MEANS OF A FLOATING MAGNET MODEL. Pye, J. P.; Rose-Innes, A. C. (Univ. of Manchester, Eng.). Cryogenics; 13: No. 4, 216-218(Apr 1973).

The fact that a fluxon lattice must be deformable in order to be strongly pinned by a random array of pinning centers is demonstrated by experiments on a floating magnet model of the mixed state of a type-II superconductor. The experiments show that though an elastic lattice is strongly pinned by a random array of pinning centers, a rigid lattice is only weakly pinned by the same array of pinning centers. (auth)

6915 PREDICTION OF FLUX JUMPS IN TYPE II SUPERCONDUCTORS. Morton, N.; Darby, M. I. (Univ. of Salford, Eng.). Cryogenics; 13: No. 4, 232-235(Apr 1973).

The appropriate magnetic and thermal diffusion equations for magnetization of a "hard" type-II superconductor have been solved numerically using a digital computer, and show the initiation of flux jumps at applied field strengths in agreement with experimentally observed magnitudes. (auth)

6916 CURRENT HYSTERESIS IN THE INTERMEDIATE STATE OF THIN-FILM SUPERCONDUCTORS. Huebener, R. P.; Kampwirth, R. T. (Argonne National Lab., IL). J. Low Temp. Phys.; 7: No. 3-4, 229-239(May 1972).

The current hysteresis was studied at 4.2 K in the intermediate state of superconducting lead films using electrical resistance measurements and high-resolution magnetooptical observations of the magnetic flux structure. At low magnetic fields the liquidlike arrangement of the flux structure in the form of multiquanta flux tubes was found to persist following the application of a high electrical transport current with an average current density of 10^5 to 10^6 A/cm^2. In this field range a reduction of the resistive voltage was observed following the application of a high transport current. This inverse current hysteresis appears to be associated with a shift of the magnetic flux structure in the direction of the current-induced flux motion resulting in an extended fluxfree region along the sample edge where flux tubes enter the film during flux motion. At higher magnetic fields, where the laminar flux structure is the stable configuration, the usual resistive voltage enhancement was observed following the application of a high transport current. In this regime the laminae rearrange themselves under the influence of a transport current resulting in a preferential orientation perpendicular to the current. (auth)

6917 INVESTIGATION OF THE VERY INCOMPLETE MEISSNER EFFECT. Rabinowitz, M.; Garwin, E. L.; Frankel, D. J.. (Stanford Univ., CA). Lett. Nuovo Cim.; 7: No. 1, 1-4(5 May 1973).

Experimental evidence is reported for stable trapping of dipole, quadrupole, and sextupole fields transverse to the axes of superconducting cylinders of lead, niobium, and Nb_3Sn. Large amounts of flux are trapped, and the field magnitudes and shapes are preserved to reasonable accuracy. It is found that centrally there is less than 5% flux exclusion, that is, virtually no Meissner effect in these materials from low field levels to fields $\sim H_c$ for lead and niobium. (JFP)

6918 EFFECT OF THE PRESSURE AND PARAMAGNETIC IMPURITY ON SUPERCONDUCTIVE PROPERTIES OF METALS. Palistrant, M. E. (Inst. of Applied Physics, Kishinev, USSR). Teor. Mat. Fiz.; 15: No. 2, 280-287(May 1973). (In Russian).

The superconductor is studied, the Fermi surface topology of which is changing due to the effect of the pressure and paramagnetic impurity. The equations are obtained, by which the ordering parameter Δ and the critical temperature T_c of such a superconductor are determined. It is found that T_c is increasing nonlinearly with the growth of the parameter $\epsilon_F' = \epsilon_F - \epsilon_k$ for the different concentrations of the impurity, when the new part of the Fermi surface is arising, and is decreasing nonlinearly when the open Fermi surface changes into the closed one. The nonlinearity becomes more smooth when the concentration of the impurity becomes greater. The impurity dependence of T_c with the fixed value of the parameter ϵ_F' is investigated. The impurity contribution into the quantity T_c, connected with the changes of the Fermi surface topology, turns out to be significant. The changes of the critical concentration of the impurity with the growth of the quantity ϵ_F' is also investigated. (auth)

6919 KVANTOVAYA TEORIYA SISTEM MNOGIKH CHASTITS. (Quantum Theory of Many-Particle Systems). Bezruchko, V. N. (ed.). Kishinev; Izdatel'stvo Shtiintsa (1973). 144p.

Nine papers by different authors are included in this book which deal with the theory of superconductivity and the theory of the nucleus and nuclear reactions. Topics treated are as follows: the effect of changes in the topology of the Fermi surface of superconductors, superconductors under pressure, a rotating model of odd atomic nuclei, density of electron states of two-zone superconductors, inelastic $\pi-N$ and $N-N$ interactions, thermodynamics of single-zone superconductors, and the interactions of high-energy particles and relativistic nuclei with nuclei. (KSW)

Equipment and Devices

Refer also to abstracts 5782, 6495, and 6497.

6920 (CEA-CONF-2232) D.C. MAGNETS. Bronca, G. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 13 Oct 1972. 40p. (CONF-721086-1). Dep. NTIS (U. S. Sales Only) $4.00.

From conference on electromagnets with continuous current; Titisee, F. R. Germany (9 Oct 1972).

Problems in the development of superconducting dc magnets are summarized. The conductor, the winding, cooling, iron shielding and forces, refrigeration, and projects and construction are reviewed. (MHR)

6921 CRYOGENIC TECHNIQUE AT AND BELOW 4.2°K AND ITS APPLICATION TO MATERIALS RESEARCH. Erdmann, J. C. (Boeing Scientific Research Labs., Seattle). pp 1-115 of Techniques Involving Extreme Environment, Nondestructive Techniques, Computer Methods in Metals Research, and Data Analysis. Bunshah, R. F. (ed.). New York; John Wiley and Sons, Inc. (1972).

A survey is presented of the most common techniques used in solid-materials investigations both for the maintenance and use of temperatures ≤ 4.2°K. Basic cryogenic techniques discussed include He cryostats, thermometry, temperatures < 4.2°K controlled by He evaporation, ^{3}He cryostat, ^{3}He$-^4$He dilution refrigerator, adiabatic demagnetization, and engineering aspects of materials for cryogenic applications. Special measuring techniques for ≤ 4.2°K which are discussed include those for electric conductivity, thermal conductivity, heat capacity, elastic constants, thermal expansion, plastic properties, high pressure, radiation damage, superconductivity, magnetic susceptibility, Moessbauer effect, optical studies, and He(II) quenching of vacancies. (39 figures, 528 references) (DLC)

6922 ELECTROMAGNETIC DEVICES. Jones, J. E.; Lanning, J. R. (to British Oxygen Co. Ltd.). British Patent 1,310,223. 14 Mar 1973. Filed date 5 Jun 1969. 3p.

Reference is made to superconducting electromagnets. A problem associated with these devices is the dissipation of large amounts of Joule heat generated when the device is "quenched". When the conductors are immersed in liquid He this sudden generation of heat vaporizes large quantities of the liquid, which can lead to possibly dangerous over-pressures in the apparatus. The arrangement described aims at over-coming this problem by using composite superconductors indirectly cooled by He either in the liquid state or supercritical vapor state. The superconductors are in the form of very fine filaments embedded in a matrix of normal material that acts as a shunt path for the flow of current in the event of parts of the filaments going "normal". Constructional details are given. (UK)

6923 SUPERCONDUCTIVE DC TRANSMISSION LINES: DESIGN STUDY AND COST ESTIMATES. Carter, C. N. (Central Electricity Research Labs., Leatherhead, Eng.). Cryogenics; 13: No. 4, 207-215(Apr 1973).

A conservative design study of a dc superconductive power line based on present day technology is presented. Power is transmitted by opposing currents in coaxial conductors, formed from helically wound tapes of composite, with a potential difference between them. Conductor temperature stability and fault current conditions are shown to be the factors which dominate the conductor cost; both are analyzed. The capital cost of a cable is expressed as a function of a cable dimension, the basic cable parameters, and the material properties. This cost may be minimized with respect to cable radius. The resultant optimum magnetic fields vary little with power rating and are quite low at about $1\text{-}2 \times 10^5$ A m^{-1}. The capital cost of such cables, exclusive of terminal costs, is less than the cost of conventional dc cables at power levels above about 1 GVA. Although extensive development would be necessary, the basic principles needed to build a dc superconductive cable are known. (auth)

6924 INSTALLATION FOR INVESTIGATING CRYOGENIC ELECTROMECHANICAL INSTRUMENTS AND DEVICES. Kolodeev, I. D.; Kalinin, V. Ya.; Sudovtsov, A. I.; Shevchenko, T. G. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1583-1584 (1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 247-248(1972).

A description is given of an experimental installation with a laboratory metallic cryostat designed for investigations of superconducting electromechanical devices in liquid He. The installation differs from well-known ones in the equipment provided for ensuring the operation of the investigated devices and the cryostat which has a cavity containing liquid N_2 in its neck above the helium tank; the liquid N_2 plays the role of a heat shield. The use of such a shield allowed considerable reduction of the heat influx to the coolant and permitted the possible time available to perform the experiment without increasing the discharge of liquid He to be increased by a factor of 3 to 4. (auth)

6925 SWEEP AND MODULATION OF A UNIFORM MAGNETIC FIELD IN A CLOSED SUPERCONDUCTING SOLENOID. Permyakov, V. V. (Physical-Technical Inst., Donetsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1579-1580(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 244-245(1972).

The possibility of the effective sweep and modulation of a magnetic field in a closed superconducting solenoid having a maximum field intensity of 45 kOe and a field uniformity of $2 \cdot 10^{-5}$ in the volume of a cylinder 10 mm long and 5 mm in diameter is considered. The modulation with an amplitude 150 Oe at a frequency of 0 to 500 Hz and the sweep of the magnetic field with a maximum value of up to 2 kOe and a rate of 0.2 to 200 Oe/sec have a uniformity of at worst $2 \cdot 10^{-5}$ relative to the maximum field of the solenoid in the working zone. (auth)

6926 NONDETACHABLE ECONOMICAL CURRENT LEAD FOR SUPERCONDUCTING MAGNETIC SYSTEMS. Lavrova, V. V.; Rachitskii, D. G.; Fisher, L. M.; Yudin, V. A. (All Union Electrical Engineering Inst., Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1581-1582(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 246-247(1972).

A current lead is described for a current of up to 200 A, which does not have a detachable electrical connection at low temperatures. With the supply source switched off, the entire current lead, which is based on thin-walled stainless-steel tubes, is lowered inside the cryostat; the thermal influx along the current lead in this position is reduced substantially. The current lead may be used to supply superconducting solenoids which operate either periodically or in a short-circuit mode. (auth)

6927 STABILIZED CURRENT SOURCE FOR SUPPLYING SUPERCONDUCTING SOLENOIDS. Voronin, V. I. (Inst. of Physical Problems, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1475-1477(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 159-161(1972).

A circuit is described for stabilized current source rated at 0 to 180 A for supplying superconducting solenoids. The resistance of the lead wires is $3 \cdot 10^{-3}\ \Omega$. The current stability is better than 10^{-4}. Automatic current sweep in the interval from 1 to 180 A is provided for. Reversing of the sweep and stopping at any spot along the sweep are allowed. The elapsed time of an interval can be controlled in the range from 2 to 90 min. The current-pulsation level is $\sim 10^{-6}$ for a solenoid having an inductance of 0.5 H. The power drawn from the line is 350 W. (auth)

6928 DEVICE FOR STABILIZING THE CURRENT OF A SUPERCONDUCTING SOLENOID. Kiselev, Yu. F. (Joint Inst. for Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1478-1480(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 162-163(1972).

A compact (360 × 410 × 490 mm) precision current stabilizer rated at 0 to 100 A for stabilizing the current of the superconducting solenoid is described. An integrated microcircuit of the 1UT401 type is used. The current instability is $7 \cdot 10^{-6}\ h^{-1}$. The temperature instability is $2 \cdot 10^{-6}/°C$. Automatic input (output) of current into (from) the solenoid is provided, as well as sweep in the range from 0 to 6% of the principal current. The rate of current input (output) and the sweep rate can be controlled smoothly. The principle allows calibrated current shifts of up to 0.002% to be achieved. (auth)

6929 EXPERIMENTAL FLUX SHUTTLE. Fulton, T. A.; Dunkleberger, L. N. (Bell Laboratories, Murray Hill, New Jersey 07974). Appl. Phys. Lett. 22: No. 5, 232-233 (1 Mar 1973).

We report the operation of an experimental model of the Josephson junction shift register known as the flux shuttle. (auth)

6930 STUDY OF THE GEOMETRICAL RESONANCES OF SUPERCONDUCTING TUNNEL JUNCTIONS. Soerensen, O. Hoffmann; Finnegan, T. F.; Pedersen, N. F. (Physics Laboratory I, The Technical University of Denmark, DK-2800 Lyngby, Denmark). Appl. Phys. Lett. 22: No. 4, 129-131 (15 Feb 1973).

The resonant cavity structure of superconducting Sn-Sn-oxide-Sn tunnel junctions has been investigated via photon-assisted quasiparticle tunneling. We find that the temperature-dependent losses at 35 GHz are determined by the surface resistance of the Sn films for reduced temperatures between 0.5 and 0.8. Our results are in very good agreement with the microscopic theory of Mattis and Bardeen for the surface resistance of Sn. (auth)

6931 JOSEPHSON JUNCTION ANALOG AND QUASIPARTICLE-PAIR CURRENT. Bak, C. K.; Pedersen, N. F. (Physics Laboratory I, The Technical University of Denmark, DK-2800 Lyngby, Denmark). Appl. Phys. Lett. 22: No. 4, 149-150 (15 Feb 1973).

A close analogy exists between a Josephson junction and a phase-locked loop. A new type of electrical analog based on this principle is presented. It is shown that the inclusion in this analog of a low-pass filter gives rise to a current of the same form as the Josephson quasiparticle-pair current. A simple picture of the quasiparticle-pair current, which gives the right dependences, is obtained by assuming a junction cutoff frequency to be at the energy gap. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 7083 and 7210.

6932 (AERE-PR/NP-18, pp 1-2) FAST NEUTRON SPECTRA FROM SPHERICAL SHELLS OF REACTOR MATERIALS. Williams, J. C. (Imperial Coll. of Science and Tech., London); Goddard, A. J. H.; Lichtblau, H. Mar 1972.

6933 (AERE-R-7302) MONTE CARLO COMPUTER PROGRAM FOR NEUTRON ELASTIC SCATTERING SIMULATION. Meardon, B. H. (Atomic Energy Research Establishment, Harwell (England)). Jan 1973. 87p. Dep. NTIS (U. S. Sales Only) $6.50. UK £ 1.50 pence.

This report describes a program which performs computer simulation of neutron elastic scattering using Monte Carlo techniques. The FORTRAN IV code NESS (Neutron Elastic Scattering Simulation), which performs the evaluation, is listed together with a full description of the program and a few illustrations of the use of the technique. The method is of great importance for the correction of neutron scattering data for multiple Bragg scattering and for the correction of diffuse scattering data for the combined effects of multiple scattering, absorption, and sample geometry. The program may also be used for establishing the optimum sample geometry and size prior to the actual experiment, and for investigating the experimental effects of counter geometry, filter geometries, etc. (8 figures, 3 tables) (auth)

6934 (ANCR-1022) RAFFLE GENERAL PURPOSE MONTE CARLO CODE. Vesely, W. E.; Wheeler, F. J.; Marsden, R. S. (Aerojet Nuclear Co., Idaho Falls, Idaho). Apr 1973. Contract AT(10-1)-1375. 243p. Dep. NTIS $7.60.

The RAFFLE code is a three-dimensional general-purpose Monte Carlo program for the solution of static neutron transport problems. It is written in FORTRAN IV, and is presently operational on the IBM 360/75 computer. Either fission-source iteration or external-source problems can be solved. The external sources can be distributed volume sources or current sources defined on specified surfaces, and these sources can optionally generate fission daughters. Groupwise reaction rates and fluxes for up to 100 energy groups can be obtained for all regions of interest. Instead of reaction rates, cell-averaged groupwise cross sections together with P_0 and P_1 transfer matrices can be obtained in addition to the fluxes. Multiplication factors, lifetimes, and generation times are also computed. For each RAFFLE estimate, the fractional probable error is also given. Optimal multiple thermal groups make RAFFLE suitable for studies of complex thermal or coupled fast-thermal systems. Groupwise currents from any region to any adjacent region can be calculated. RAFFLE has the capability of handling all practical geometrical models. Detailed spatial information can be produced by use of small regions, or edits can be obtained for sets of regions to show averaged behavior. In the same way, groups can be combined into group sets. RAFFLE can use either multigroup or pointwise cross section data. A combination of the two types can also be used. Hence, cross section data can be extremely detailed if required, or they can be very coarse. Inelastic discrete-level and evaporation-model scattering; resolved-resonance absorption, scattering, and fission; and elastic scattering with any degree of anisotropic angular scattering can all be treated. Three scoring techniques and a number of biasing options can be selected to make the Monte Carlo procedures of RAFFLE effective for a wide variety of problems. (42 figures, 28 tables) (auth)

6935 (CONF-730611-1) CROSS SECTION SENSITIVITY ANALYSIS FOR DISCRETE ORDINATES CALCULATIONS. Bartine, D. E.; Oblow, E. M.; Mynatt, F. R. (Oak Ridge National Lab., Tenn.). 1972. 6p. Dep. NTIS $3.00.

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973).

Cross section sensitivity analysis refers to a determination of how sensitive a calculated quantity or result is to microscopic cross section data utilized in the calculation. The sensitivity function used here represents an application of earlier perturbation approaches. The principles of the method are discussed briefly. As an example, a one-dimensional air transport problem with a thermonuclear neutron source was investigated. The sensitivity of total tissue dose to specific reaction cross sections for N and O was determined. (1 table) (RWR)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 6781 and 6802.

6936 (AERE-PR/NP-18, pp 21-22) (γ,n) CROSS SECTION MEASUREMENTS NEAR THRESHOLD. Patrick, B. H.; Bowey, E. M. Mar 1972.

6937 (AERE-PR/NP-18, p 34) MEASUREMENT OF THE DIFFERENTIAL ELASTIC N-P SCATTERING CROSS SECTION AT 130 MeV. Howard, V. J.; Das Gupta, S. S.; Edgington, J. A.; Bonner, B. E.; Baker, C. A.; Blair, I. M.; Brady, F. P. Mar 1972.

6938 (AERE-PR/NP-18, p 35) KINEMATICALLY COMPLETE EXPERIMENT ON THE d(n, np)n REACTION. McNaughton, M. W. (Kings Coll., London); Stewart, N. M.; Griffiths, R. J.; Edgington, J. A.; Bonner, B. E.; Blair, I. M. Mar 1972.

6939 (AERE-PR/NP-18, pp 44-45) SMALL-ANGLE PROTON-PROTON SCATTERING CROSS SECTIONS AT 144 MeV. Jarvis, O. N.; Whitehead, C.; Shah, M.; Sherwood, A. C. Mar 1972.

6940 (ITF-72-162-E) PROBLEM OF FOUR IDENTICAL PARTICLES WITH SEPARABLE INTERACTION. Kharchenko, V. F.; Kuzmichev, V. E. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

The problem of four identical spinless particles with separable pair interactions is considered. The integral equations of motion for four particles are formulated in the case of bound states of the system and of continuum states when the system asymptotically consists of two noninteracting subsystems. The calculations are performed in the case of the four-particle bound states. Besides the ground state of the four-particle system, a second O^+ bound state is found. Its binding energy slightly exceeds the binding energy of the ground state of three particles. In the approach, when the wave function of the system is approximated by a completely symmetrical function, the energy of the ground state of ^{9}He is calculated. (auth)

6941 (JINR-P2-6981) APPLICATION OF ACCELERATED CONVERGENCE EXPANSION FOR THE PHASE SHIFT ANALYSIS OF THE ELASTIC $\pi^{\pm 4}$He SCATTERING. Dumbrais, O. V.; Nikitinu, F.; Shcherbakov, Yu. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The phase shift analysis of the elastic $\pi^{\pm}He^4$ scattering in the energy range of 25-180 MeV has been carried out by means of the accelerated convergence expansion. The results of this analysis are compared with those of conventional analysis. The possibility of the more realistic estimation of the higher partial wave contribution is discussed. (auth)

6942 AMBIGUITIES IN π ^{4}He PHASE-SHIFT ANALYSIS. Nichitiu, F. (Joint Inst. for Nuclear Research, Dubna, USSR). Lett. Nuovo Cim.; 6: No. 15, 597-602(14 Apr 1973).

It is shown that by taking into account unitary conditions and the total cross section the unacceptable sets of phase shifts can be eliminated for the case of $\pi^{\pm}$ scattering on ^{4}He. (LBS)

6943 EVALUATION OF DALITZ-PLOTS. II. Kamke, D. (Univ., Bochum, Ger.). Ann. Phys. (Leipzig); 28: No. 3, 193-204(1972).

For nuclear reactions with three particles in the final state inner parameters are defined. Particular experimental arrangements are discussed with respect to the behavior of the inner parameters. It is shown that a complete and rather detailed survey of the kinematical relations in the laboratory system can be given, including the variations when the total energy (determined by the incoming particle's energy of a nuclear reaction) is changed. (auth)

6944 THEORETICAL ANALYSIS OF THE NUCLEON SPECTRA FROM THE REACTION $n + d \rightarrow n + n + p$. Komarov, V. V.; Povozhilova, V. N.; Popova, A. M. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 177-182(Jan 1973). (In Russian).

An analysis was made of the existing methods of theoretical investigation of nucleon spectra from the deuteron disintegration reaction under the action of neutrons. Partial solutions of the integral equations were used for the amplitudes of the reaction indicated. (2 figures) (tr-auth)

6945 INVESTIGATION OF THE WAVE FUNCTION ZEROS OF MUTUAL MOTION OF THE αd- AND τt-LIGHTEST NUCLEI USING THE SCATTERING PHASES AND QUASIELASTIC KNOCK OUT FORM FACTORS. Korennoi, V. P.; Kurdyumov, I. V.; Neudachin, V. G.; Smirnov, Yu. F. (Moscow State Univ.). Yadern. Fiz.; 17: No. 4, 750-760(Apr 1973). (In Russian).

The phase shifts and differential cross sections of αd and τt scattering are obtained on the basis of the concept of deep optical potentials with forbidden states. It is shown that the effects of supermultiplet symmetry in light nucleus scattering leads to the splitting of the optical potential for states with different parity. Analytical expressions for form factors of αd and τt scattering are given based on the nucleon cluster model. The problem of experimental study of the wave function zeros of relative nuclear motion in the interaction region is discussed. (5 figures, 2 tables) (auth)

Nuclear Properties and Reactions, $6 \leq A \leq 19$

Refer also to abstracts 5617, 6738, 6802, 6943, 6945, 6973, 7000, 7013, 7058, 7087, and 7089.

6946 (AERE-PR/NP-18, pp 14-16) MEASUREMENT OF STANDARD CROSS SECTIONS USING THE HARWELL BLACK DETECTOR. Coates, M. S. (Imperial Coll. of Science and Tech., London); Hunt, G. J.; Uttley, C. A. Mar 1972.

6947 (AERE-PR/NP-18, pp 16-19) SPIN DEPENDENCE OF THE S-WAVE NEUTRON INTERACTION WITH ^{6}Li. Uttley, C. A. Mar 1972.

6948 (AERE-PR/NP-18, pp 31-32) (p,n) REACTIONS IN p-SHELL NUCLEI. Langsford, A.; Bell, R. A. Mar 1972.

6949 (AERE-PR/NP-18, p 37) ^{6}Li(p,^{3}He)^{4}He REACTION. Hooton, B. W.; Ivanovich, M. Mar 1972.

6950 (AERE-PR/NP-18, pp 38-40) $0^+ \to 0^+$ SUPER-ALLOWED β DECAYS AND THEIR RELATION TO WEAK INTERACTION THEORY. Clark, G. J.; Freeman, J. M.; Draper, J. E.; Ryder, J. S.; Burcham, W. E.; Squier, G. T. A. Mar 1972.

6951 (AERE-PR/NP-18, p 43) COULOMB-INTERFERENCE IN PROTON–NUCLEUS SCATTERING AT 144 MeV. Jarvis, O. N.; Shah, M.; Whitehead, C.; Sherwood, A. C. Mar 1972.

6952 ^{16}O + d REACTIONS AT $E_d < 2$ MeV. Cavallaro, S.; Cunsolo, A.; Potenza, R.; Rubbino, A. (Univ., Catania, Italy). Nuovo Cim. 14A: No. 4, 692-710(21 Apr 1973).

The reactions induced by deuterons on the ^{16}O nucleus were studied for all the open channels in the energy range $0.98 \leq E_d \leq 1.97$ MeV. The absolute differential cross sections for the elastic scattering of the ^{16}O(d,p$_0$)^{17}O, ^{16}O(d,p$_1$)^{17}O* and ^{16}O(d,α_0)^{14}N reactions are presented and compared with the results of other authors. The analysis of the cross sections is done in terms of direct and statistical components. Care was taken in using channel-independent and mechanism-independent sets of optical parameters for the deuterons, protons and α-particles respectively. As found by other authors, also in this case it was necessary to reduce the computed statistical cross sections to get an agreement between theory and experiment. The reduction factor k turned out to be channel-independent, as expected from theory. (auth)

6953 MICROSCOPIC DESCRIPTION OF THE FIRST TWO LEVELS OF ^{9}Be. Fuld-Rouserez, M. (Univ. Libre, Brussels). Bull. Cl. Sci., Acad. Roy. Belg.; 58: 894-911(1972). (In French).

A microscopic calculation of the intrinsic energies of the ground state and of the first positive-parity state (at 1.75 MeV) of the ^{9}Be nucleus is presented. The cluster model of Brink is generalized to a two-α particle system with an additional neutron described by means of a definite-parity molecular wave function. The variational calculation is made by using spherical and spheroidal orbitals. (4 figures, 5 tables) (auth)

6954 (α,α), (α,α'), AND (α,^{3}He) REACTIONS ON ^{12}C AT 139 MeV. Smith, S. M.; Tibell, G.; Cowley, A. A.; Goldberg, D. A.; Pugh, H. G.; Reichart, W.; Wall, N. S. (Univ. of Maryland, College Park). Nucl. Phys., A; A207: No. 2, 273-288(1973).

The nucleus ^{12}C was bombarded with 139 MeV α-particles to study the characteristics of the elastic, inelastic, and (α,^{3}He) reactions. An optical model analysis of the elastic data yielded a unique family of Woods–Saxon potential parameters with central real well depth $V \approx 108$ MeV, and volume integral $J/4A \approx 353$ MeV $\cdot$ fm^3. By comparing the present results with those of other studies above 100 MeV, it is found that the real part of the α-nucleus interaction decreases with increasing energy; the fractional decrease with energy is roughly one-half that observed for proton potentials. Using the optical potential parameters derived from the elastic scattering, first-order DWBA calculations with complex first-derivative form factors reproduced the inelastic scattering data to the 4.44 MeV (2^+) and 9.64 MeV (3^-) states of ^{12}C. For the 0^+ state at 7.65 MeV it was necessary to employ a real, second-derivative form factor to fit the data. The deformation lengths $\beta_l R_m$ and deformations β_l obtained in this and other experiments are summarized and compared. DWBA calculations using microscopic model form factors were also performed for the 2^+ and 3^- states using the wave functions of Gillet and Vinh Mau. These reproduced the shapes and relative magnitudes of the differential cross sections. The shape of the 0^+ differential cross section was also fitted using a microscopic form factor which contains a node, which is similar to that occurring in the collective model second-derivative form factor. In the (α,^{3}He) reaction the differential cross sections to the ground state ($\frac{1}{2}^-$) and the 3.85 MeV ($\frac{5}{2}^+$) state in ^{13}C could not be reproduced by zero-range local DWBA stripping calculations; it was necessary to employ finite-range and non-local corrections in the local-energy approximation. This DWBA analysis is notable in that unambiguous optical potentials were available for both entrance and exit channels. The ground state spectroscopic factor is in agreement with the prediction of Cohen and Kurath, while the relative spectroscopic factors agree fairly well with the rather few existing measurements of this kind. (auth)

6955 QUASI-FREE SCATTERING IN THE ^{6}Li(d,dα)^{2}H REACTION AT 52 MeV. Hagelberg, R. (Univ., Karlsruhe, Ger.); Haase, E. L.; Sakamoto, Y. Nucl. Phys., A; A207: No. 2, 366-378 (1973).

In order to study the momentum distribution of an α-cluster in ^{6}Li the quasi-free scattering of deuterons in the ^{6}Li(d,dα)^{2}H reaction, using 52 MeV deuterons, was investigated. The α-particle detector was kept at a fixed position of 30° and the second detector scanned over a range of coplanar angles. The α-cluster momentum distribution was extracted by means of the plane-wave impulse approximation, using both the energy-sharing method and the angular correlation method. The momentum distributions so obtained are in good agreement with those obtained from other reactions such as (p,pα) and (α,2α), and are compared with the spectator model. The reasons why the model works well are discussed. For the first time, to our knowledge, quasi-free scattering of deuterons on an α-cluster of a nucleus was measured and analyzed. (auth)

6956 NUCLEAR PHOTOSPALLATION IN THE ENERGY RANGE 2 TO 4.5 GeV. Vartapetyan, G. A. (Inst. of Physics, Erevan); Danagulyan, A. S.; Demekhina, N. A.; Khudaverdyan, A. G. Yadern. Fiz.; 17: No. 4, 685-691(Apr 1973). (In Russian).

The yields of the photonuclear reactions $^{12}C \to {}^{11}C$, $^{55}Mn \to {}^{54}Mn$, $^{55}Mn \to {}^{52}Mn$, $^{27}Al \to {}^{24}Na$, $^{27}Al \to {}^{18}F$, $Si \to {}^{24}Na$, $Si \to {}^{18}F$, $S \to {}^{24}Na$, $S \to {}^{18}F$, $Cl \to {}^{24}Na$, $Cl \to {}^{18}F$, $K \to {}^{24}Na$, $K \to {}^{18}F$, $Ca \to {}^{24}Na$ are measured by the induced activity method in the energy range of bremsstrahlung spectrum 2 to 4.5 GeV. The upper limits for cross sections of reactions $^{27}Al \to {}^{24}Na$, $Si \to {}^{24}Na$, $S \to {}^{24}Na$, $Cl \to {}^{24}Na$, $K \to {}^{24}Na$, $Ca \to {}^{24}Na$ are calculated at the photon energy more than 2 GeV. The obtained experimental data on the spallation of the above nuclei are reasonably explained using semiempirical Rudstam formula. (auth)

6957 PHOTODEUTERONS OF GIANT RESONANCE OF ^{15}N NUCLEUS. Denisov, V. P.; Chubukov, I. Ya. (Inst. of Nuclear Physics, Leningrad). Yadern. Fiz.; 17: No. 4, 682-684(Apr 1973). (In Russian).

From analysis of energy distributions for photodeuterons of ^{15}N nucleus, measured at various maximum energies of bremsstrahlung it was found, that as a result of ^{15}N(γ,d)^{13}C reaction the final nucleus ^{12}C remains in the ground state if $E_\gamma < 25$ MeV. The integral cross section for this reaction (1.0 ± 0.3 MeV $\cdot$ mbn) is 4% of integral cross section for ^{15}N(γ,p)^{14}C reaction in the interval E_γ = 19.5 to 25 MeV. (auth)

6958 GAMMA RADIATION PRODUCED BY THE INELASTIC INTERACTION OF 660-MeV PROTONS WITH CARBON, OXYGEN, ALUMINIUM, AND SILICON NUCLEI. Zul'karneev, R. Ya.; Moskaleva, L. P.; Nadezhdin, V. S.; Surkov, Yu. A.; Kharyukova, V. P.; Shekhanov, G. A. pp 246-253 of Prikladnaya Yadernaya Spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

6959 NEUTRON POLARIZATION IN REACTION ^{9}Be(α,n)^{12}C. Okorokov, V. V.; Serezhin, V. M.; Smotryaev, V. A.; Tolchenkov, D. L.; Trostin, I. S.; Cheblukov, Yu. N. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 17: No. 4, 678-681(Apr 1973). (In Russian).

Using a ^{4}He scintillation chamber as a polarimeter and by means of the time of flight method, the neutron polarization from reaction ^{9}Be(α,n)^{12}C corresponding to the ground and first excited states of the ^{12}C nucleus is measured within the angles of neutron emission $\theta_n = 30$ to 120°. The neutron polarization corresponding to the ground state of ^{12}C exceeds 40% and for neutrons of excited states of ^{12}C achieves ~25%. (auth)

6960 DIFFRACTION SCATTERING OF PROTONS ON DEFORMED ^{12}C NUCLEUS. Dotsenko, I. S.; Foursat, A. D. (Inst. of Theoretical Physics, Kiev). Yadern. Fiz.; 17: No. 4, 783-787 (Apr 1973). (In Russian).

Proton scattering on the ^{12}C nucleus is considered in the diffraction approximation. The wave functions constructed of one-particle functions describing the nucleon states in the averaged potential of the anisotropic harmonic oscillator are used to describe the states of the ^{12}C nucleus. The cross section of elastic and inelastic (with the excitation of 2^+ level) scattering of 1000 MeV protons is calculated. The calculation is made in small deformation approximation. The parameter of deformation of the ^{12}C nucleus is found from the condition of the best agreement of the calculated cross section of elastic scattering with the experimental data. (auth)

6961 ELASTIC AND INELASTIC SCATTERING OF FAST NUCLEONS AND CLUSTER STRUCTURE OF ^{6}Li. Dotsenko, I. S.; Foursat, A. D. (Inst. of Theoretical Physics, Kiev). Yadern. Fiz.; 17: No. 4, 770-782(Apr 1973). (In Russian).

Proton scattering by ^{6}Li nuclei is considered in the diffraction approximation. The wave functions of the nucleon association model with the parameters explaining the mean square radii of nucleon distributions in α-particle, deuteron and ^{6}Li are used to describe the states of the ^{6}Li nuclei. The formulas for differential cross sections of elastic and inelastic proton scattering with the excitation 3^+ T = 0(2.18 MeV)-state of ^{6}Li are obtained in analytical form, and the calculations of these cross sections are made at 185 MeV. The influence of the form of the wave function describing relative motion of associations in the ground state on the differential cross sections is studied. (auth)

6962 INELASTIC SCATTERING OF PROTONS BY ^{9}Be WITH EXCITATION OF 1.68- AND 2.43-MeV LEVELS. Gubin, V. B.; Vasil'ev, S. S.; Galakhmatova, B. S.; Mikhaleva, T. N.; Romanovskii, E. A.; Chuprunov, D. L.; Nikitina, L. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 101-104(Jan 1973). (In Russian).

Inelastic proton scattering at 6.4 MeV by ^{9}Be was calculated in the distorted-wave Born approximation. Levels at 1.68 and 2.43 MeV in the ^{9}Be nuclei were excited. From a comparison with experimental data it was concluded that the scattering associated with the excited level at 1.68 MeV was correlated with a mechanism which is characterized by a rectangular diagram. (tr-auth)

6963 INELASTIC SCATTERING OF DEUTERONS BY ^{9}Be NUCLEI. Vasil'ev, S. S.; Galakhmatova, B. S.; Dem'yanova, A. S.; Mikhaleva, T. N.; Romanovskii, E. A.; Chuprunov, D. L.; Nikitina, L. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 105-106(Jan 1973). (In Russian).

The inelastic scattering of 12.8-MeV deuterons from the 1.68-MeV excited level in ^{9}Be was studied. The results of the measurements were compared with the predictions of models of inelastic deuteron scattering. (2 figures) (tr-auth)

6964 HIGH-ENERGY NEUTRONS FROM MUON CAPTURE BY COMPLEX NUCLEI. Eramzhyan, R. A.; Salganic, Yu. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys.; A207: No. 3, 609-618(1973).

The neutron channel in muon capture by complex nuclei, $\mu^- + (A, Z) \rightarrow (A-1, Z-1) + n + \nu$, is investigated. The calculation is made for the nucleus ^{16}O. The transitions to the $\frac{1}{2}^-$(g.s.), $\frac{3}{2}^-$(6.33 MeV), $\frac{1}{2}^+$ and $\frac{5}{2}^+$(5.3 MeV) levels of ^{15}N are considered. It is shown that the final-state interaction between an outgoing neutron and the residual nucleus changes the monotonic energy dependence of the high-energy asymmetry as predicted in a plane-wave approximation. When the transitions to definite states of the final nucleus are singled out, one can obtain detailed information and identify the main features of muon capture with high-energy neutron emission. (6 figures) (auth)

6965 THREE PARTICLE STRUCTURE OF ^{19}F. Rogers, D. W. O. (Nuclear Physics Lab., Oxford). Nucl. Phys.; A207: No. 3, 465-485(1973).

A detailed comparison is made between over 100 experimental decay strengths from positive-parity states in ^{19}F and the predictions of $(sd)^3$ shell-model calculations using Kuo or Kallio-Kolltveit matrix elements. It is shown that the K = $\frac{1}{2}^+$ and $\frac{3}{2}^+$ bands (except for the 3907-keV level), along with several other levels, can be explained by these calculations. The levels at 3907, 5336, and 5497 keV are shown to be intruder states. Emphasis is placed on showing where the predictions are sensitive to the residual interaction used. (5 figures, 10 tables) (auth)

6966 PHOTONUCLEAR REACTIONS ON ^{6}Li WITH EMISSION OF CHARGED PARTICLES. Denisov, V. P.; Kul'chitskii, L. A.; Chubukov, I. Ya. (Inst. of Nuclear Physics, Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 107-117(Jan 1973). (In Russian).

A series of energy distributions of protons, deuterons, and tritons were measured with counter telescopes. These particles were formed by the interaction of ^{6}Li with bremsstrahlung at 36 different values of the maximum energy over the interval 20 to 57 MeV. The cross section of the (γ,p) reaction was determined with the formation of the final nucleus ^{5}He in the ground and first and second excited states. The (γ,t) reaction was similarly studied. (8 figures, 2 tables) (tr-auth)

6967 CHARACTERISTICS OF THE HIGHLY EXCITED STATES OF THE ^{12}C NUCLEUS FROM AN ANALYSIS OF THE ^{11}B(p,3α) REACTION. Komarov, V. V.; El'-Takhavi, M. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 122-125(Jan 1973). (In Russian).

The energy spectra of α particles from the reaction ^{11}B(p,3α) were determined for incident proton energies of 680 keV, 1.4 and 2 MeV and for different angles of the detector assembly. Experimental and calculated data were compared for the three excited states of the ^{12}C nucleus at 16.57, 17.23, and 17.77 MeV. (KSW)

6968 ELASTIC SCATTERING OF 11.6-MeV VECTOR POLARIZED DEUTERONS BY ^{14}N, ^{16}O, ^{20}Ne, and ^{22}Ne. Brown, R. C.; Griffith, J. A. R.; Karban, O.; Mesko, L.; Nelson, J. M.; Roman, S. (Univ. of Birmingham, Eng.). Nucl. Phys.; A207: No. 3, 456-464 (1973).

The vector analyzing power iT_{11}, of the elastic scattering of 11.6-MeV polarized deuterons by ^{14}N, ^{16}O, ^{20}Ne, and ^{22}Ne and the corresponding differential cross section for the latter two nuclei were measured and analyzed in terms of a standard optical potential. The optical model was found to provide a reasonable description of the experimental data. The volume integral of the real central potential was used to compare various parameters sets obtained. (auth)

6969 PHASE ANALYSIS OF ELASTIC SCATTERING OF PROTONS BY CARBON AND SILICON. Andreev, G. B.; Klyucharev, A. P.; Slabospitskii, R. P. (Physical-Technical Inst., Kharkov). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 183-188(Jan 1973). (In Russian).

Available data in the literature on polarization excitation functions for the elastic scattering of initially polarized protons with 1 to 3 MeV energies by C and Si were utilized to determine the phase shifts and differential cross sections of the pertinent reactions. Contour maps of polarization were prepared from a more accurate relationship between phase shift and energy. (6 figures, 2 tables) (tr-auth)

6970 INVESTIGATION OF THE REACTION ^{13}C(d,d$_1$)^{13}C* AT 12.8 MeV. Vasil'ev, S. S.; Galakhmatova, B. S.; Dem'yanova, A. S.; Mikhaleva, T. N.; Romanovskii, E. A.; Chuprunov, D. L.; Orlova, N. V. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 99-100(Jan 1973). (In Russian).

The inelastic scattering of deutrons by ^{13}C nuclei with the excitation of the 3.085-MeV ($\frac{1}{2}^+$) level was studied. The angular distribution was measured over the angular interval 15 to 170°. The results were compared with those calculated according to a mechanism characterized by a rectangular diagram. (2 figures) (tr-auth)

6971 EXPERIMENTAL INVESTIGATION OF NUCLEAR REACTIONS OF THE TYPE $\pi^- + {}^{16}O \rightarrow {}^{8}Li + \Sigma_{k=1}^{4}{}_{j}X_k^{1} + n$. Genchev, V.; Chernev, Kh. Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk.; 22: 89-97(1972). (In Russian).

With the help of ionographic emulsions five- and six-particle reactions, induced from the reactors of π^--mesons with the oxygen nuclei, by which is formed the fragment ^{8}Li. For the reactions $\pi^- + {}^{16}O \rightarrow {}^{8}Li + {}^{3}H + {}^{2}H + {}^{1}H + {}^{1}H + n$ and $\pi^- + {}^{16}O \rightarrow {}^{8}Li + {}^{2}H + {}^{2}H + {}^{2}H + {}^{1}H + n$ are to be proved equal to 2.94×10^{-4} and 8.60×10^{-5}. The probability of reaction without neutral particles was found to be smaller than 8.3×10^{-6}. The energy spectra of secondary particles were determined. The obtained experimental data are related to the theory of direct nuclear reactions. (auth)

6972 $\pi^{\pm}$ ^{9}Be CROSS SECTIONS, AND DETERMINATION OF THE π ^{9}Be COUPLING CONSTANT. Osland, P. (CERN, Geneva). Nucl. Phys.; B56: No. 1, 308-324(1973).

The total cross sections for $\pi^{\pm}$ ^{9}Be scattering are calculated in the Glauber model for two different nuclear models, a single-nucleon model and a cluster model. The cluster model gives much smaller cross sections than the single-nucleon model. Applying forward dispersion relations to the antisymmetric π ^{9}Be amplitude, the π ^{9}Be coupling constant was determined as $(f^2)_{eff} = 0.04 \pm 0.01$. (auth)

Nuclear Properties and Reactions, $20 \leq A \leq 38$

Refer also to abstracts 5832, 6956, 6958, 6968, 6969, and 7087.

6973 (AECL-4447) SUPERALLOWED BETA DECAY. Hardy, J. C. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Mar 1973. 25p. (CONF-730119-2). Dep. NTIS (U. S. Sales Only) $3.25. AECL $1.00.

From American Physical Society meeting; New York, New York, USA (29 Jan 1973).

Current data on the superallowed beta decay of 0^+ (T = 1) states are summarized. A more detailed description is given of recent Chalk River experiments in which the decays of $T_z = -1$ nuclei were studied in experiments that employed a gas transport system for rapidly transferring recoil nuclei from a target to a remote counting location. This work has included the first measurement of mirror Fermi decay branches within a T = 1 multiplet. These and the other data on superallowed β decay are analyzed with particular emphasis on the charge-dependent corrections to which mirror comparisons are particularly sensitive. The results are discussed in terms of the theory of weak interactions and the question of the existence of a heavy intermediate vector boson. (12 figures, 3 tables) (auth)

6974 PROPERTIES OF ^{37}Cl LEVELS OBSERVED IN THE $^{34}S(\alpha,p\gamma)^{37}Cl$ REACTION. Alenius, N. G.; Skeppstedt, Oe.; Wallander, E. (Chalmers Tekniska Hoegskola, Goteborg). Phys. Scr.; 6: No. 5-6, 303-308(1972).

The excited states of ^{37}Cl, populated in the $^{34}S(\alpha,p\gamma)^{37}Cl$ reaction at E_x = 10, 12 and 14 MeV, have been studied by γ-spectroscopy methods. The spin values $5/2^{(+)}$, $9/2^{(-)}$ and $11/2^{(-)}$ are determined for excited ^{37}Cl states at 3,087, 4,009 and 4,545 keV, respectively. (SW)

6975 PHASE TRANSITION IN THE GROUND STATE ROTATIONAL BAND OF SD SHELL NUCLEI. Faessler, A.; Goeke, K.; Muether, H. (Kernforschungsanlage, Juelich, Ger.). Phys. Scr.; 6: No. 5-6, 255-258(1972).

A similar anomaly at high angular momentum states as the "back bending" effect in rare earth nuclei is found in the sd shell. It can be quantitatively understood by a phase transition due to the Coriolis Antipairing (CAP) effect. The phase transition is calculated by performing a Hartree-Fock-Bogoliubov (HB) calculation with angular momentum projection approximately before variation (PHB). This method determines for each angular momentum the amount of pairing independently. Results obtained utilizing reaction matrix elements derived from the Hamada-Johnston potential agree in ^{22}Ne and ^{24}Ne surprisingly well with the experimental data. (SW)

6976 LIFETIMES, SPINS, AND DECAY MODES OF LEVELS BELOW 5.3 MeV IN ^{33}S. Carr, P. E.; Bailey, D. C.; Durell, J. L.; Green, L. L.; James, A. N.; Sharpey-Schafer, J. F.; Viggars, D. A. (Univ. of Liverpool). J. Phys., A (London); 6: No. 5, 685-704(May 1973).

The reaction $^{30}Si(\alpha,n)^{33}S$ was used to populate levels in ^{33}S at α-particle energies between 7.00 and 10.00 MeV. Gamma rays in ^{33}S were observed in a Ge(Li)-NaI(Tl) escape-suppressed and pair-escape spectrometer. The Döppler shift attenuation method was used to measure the mean lifetimes of 20 levels and to set limits on the lifetimes of 3 levels in ^{33}S. The analysis of angular distributions of γ rays together with the measured lifetimes and branching ratios gave γ-ray multipole mixing ratios and spin and parity assignments of $7/2^+$, $(5/2,7/2)^+$, $(3/2^+,5/2)$ and $(7/2, 11/2)^-$ for the levels at 2971, 4050, 4145, and 4868 keV, respectively. Strutinsky-type calculations have been made for ^{33}S, which give insight into the successes of the shell model and the intermediate-coupling model in describing the properties of the low-lying positive-parity states. Negative-parity states are discussed in terms of the vibrational model and collective rotational model. Mean lifetimes of four levels in ^{33}P have also been obtained, the levels being populated in the (α,p) reaction. (auth)

6977 DETERMINATION OF QUADRUPOLE COUPLING CONSTANTS OF ^{20}F IN MgF_2. Ackermann, H.; Dubbers, D.; Grupp, M.; Heitjans, P.; zu Putlitz, G.; Stoeckmann, H. J. (Univ., Heidelberg). Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1972). 4p. (In German).

From 1972 spring meeting of the German Physiology Society; Regensburg, Germany (5 Apr 1972).

Polarized ^{20}F nuclei (I = 2) were produced in tetragonal MgF_2 monocrystals by capture of polarized cold neutrons. The four hyperfine transitions $\Delta m(I) = \pm 1$ were induced by an average field of 4,350 oersted and detected as a decrease of asymmetry in ^{20}F beta decay. The quadrupole coupling constant has been determined from the transition frequency. (tr-auth)

6978 GAMMA-RAYS FOLLOWING MUON CAPTURE. Evans, H. J. (Univ. of Chicago). Nucl. Phys.; A207: No. 2, 379-400 (1973).

The energy and intensity of γ-rays following capture of muons by Si, Ti, Mn, Fe, Co, Ni, Y, Ag, and Au were measured with a Ge(Li) detector. In most cases it was possible to identify the final nucleus from the energy of the γ-ray observed. In general, this showed that one or more neutrons were emitted in the initial stages of de-excitation. In the case of capture by Fe and Ni the evidence pointed to a mode of de-excitation by the emission of a proton and a neutron and in Ti by γ-rays alone. In these measurements it was possible to account for as much as 60% of the muons captured in Co, less in the other elements, and only 15% in Si. (auth)

6979 AVERAGE ^{3}He AND α OPTICAL POTENTIALS FOR S-D-SHELL NUCLEI. Rosin, G.; Vergnes, M.; Rotbard, G.; Kalifa, J. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys., A; A207: No. 2, 353-365(1973). (In French).

Average ^{3}He and α potentials were determined which permit a quantitative analysis of the $(^3He,\alpha)$ reaction. Only one parameter is changed from one nucleus to another: the real potential depth, V, related to the nuclear radius $R = rA^{1/3}$ by the empirical formula $VR^{1.5} = K$. The parameter K independent of the mass number A and of the radius r characterizes a family. (auth)

6980 EXCITED STATES IN ^{37}Ar FROM THE $^{34}S(\alpha,n\gamma)^{37}Ar$ REACTION. Alenius, N. G.; Skeppstedt, Oe.; Wallander, E. (Chalmers Tekniska Hoegskola, Goteborg). Phys. Scr.; 6: No. 5-6, 296-302(1972).

The excited states of ^{37}Ar, populated in the $^{34}S(\alpha,n\gamma)^{37}Ar$ reaction at E_α = 10, 12 and 14 MeV, have been studied by γ-spectroscopy methods. The spin values $9/2^{(-)}$, $7/2^{(-)}$, $11/2^{(-)}$ and $9/2^{(+)}$ are proposed for excited ^{37}Ar states at 3 184, 3 526, 3 706 and 4 021 keV, respectively. (SW)

6981 SCATTERING OF PROTONS BY ^{25}Mg AND THE QUANTUM CHARACTERISTICS OF THE HIGHLY EXCITED STATES OF THE ^{26}Al NUCLEUS. Vasil'ev, S. S.; Mikhaleva, T. N.; Chuprunov, D. L. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 94-98(Jan 1973). (In Russian).

An analysis was conducted of the excitation functions of the $^{25}Mg(p,p')$ reaction in the proton energy interval from 6.18 to 6.72 MeV. I^π was determined for three resonances. (5 figures, 3 tables) (tr-auth)

Nuclear Properties and Reactions, $39 \leq A \leq 58$

Refer also to abstracts 5718, 6956, 6978, 6979, 7000, 7009, 7014, 7043, and 7090.

6982 ASYMMETRY MEASUREMENT AT SMALL ANGLES (<10°) IN THE ELASTIC SCATTERING OF 40 MeV POLARIZED PROTONS ON ^{40}A NUCLEI. Bendiscioli, G.; Gigli Berzolari, A.; Lodi Rizzini, E. (Univ., Pavia, Italy). Lett. Nuovo Cim.; 6: No. 17, 687-691(28 Apr 1973).

Preliminary results of an experimental analysis of the elastic scattering of polarized protons on ^{40}Ar at 40 MeV are reported. Asymmetry values are presented for angles $\Theta = 1°$ to 9°. It is found that the asymmetry changes sign at $\Theta \simeq 3°$ and has a negative minimum of ~0.1. (LBS)

6983 STUDY OF EXCITED STATES IN ^{51}Mn. Forsblom, I.; Weckstroem, T.; Sundius, T.; Bergstroem, G.; Forss, S.; Wansen, G. (Univ. of Helsinki). Phys. Scr.; 6: No. 5-6, 309-316(1972).

Nineteen resonances of the $^{50}Cr(p,\gamma)^{51}Mn$ reaction have been studied in the proton energy range E_p = 1000-1700 keV. The decay of the resonance states and thirty-four bound states has been investigated. The energies of the excited states were obtained with good accuracy, and the Q-value for the reaction was found to be 5270.8 ± 0.3 keV. On the basis of angular distribution measurements the following spins were proposed for the excited states: 1140 keV 9/2, 1817 keV 5/2 (7/2), 1825 keV 3/2, 1959 keV 3/2, 2140 keV 3/2, 2256 keV 7/2 (5/2), 2416 keV 7/2 (5/2), 2841 keV (1/2,3/2), 2914 keV 3/2, 3131 keV 7/2 (9/2), 6309 keV 3/2, 6694 keV 5/2 and 6840 keV 3/2. (SW)

6984 HIGH-SPIN STATES IN ^{51}Ti. Arnell, S. E.; Mattsson, C. G.; Skeppstedt, O. (Chalmers Tekniska Hoegskola, Goteborg). Phys. Scr.; 6: No. 5-6, 222-226(1972).

The ^{48}Ca(α,nγ)^{51}Ti and ^{48}Ca(α,2nγ)^{50}Ti reactions studied at 14 MeV incident energy have been used to excite high-spin states in ^{51}Ti and ^{50}Ti. By use of yield functions and $\gamma\gamma$-coincidence measurements three new high-spin states at 2344, 2754 and 3644 keV have been identified in ^{51}Ti. Angular distribution and polarization measurements make the spin values $^{11}/_{2}{}^{-}$, $^{15}/_{2}$ and $^{13}/_{2}$ or $^{17}/_{2}$ probable for the 2344, 2754 and 3644 keV levels, respectively. Two of the new high-spin states are discussed as core excited states. (SW)

6985 SECOND-ORDER EFFECTS IN THE (τ,t) REACTION. Schaeffer, R.; Glendenning, N. K. (Univ. of California, Berkeley). Nucl. Phys.; A207: No. 2, 321-341(1973).

The excitation of the 2^+ analogues in the Cu isotopes of the lowest collective 2^+ states in the Ni isotopes through the reaction Ni(τ,t)Cu is a case where the DWBA has to be corrected by two-step processes due to inelastic scattering in the initial and final states. The study of the interferences between first- and second-order terms shows that, in order to reproduce the experimental results, the effective interaction between the projectile and a bound nucleon has to be taken complex and not real, as is commonly assumed in the microscopic theory of inelastic scattering and charge exchange of helions and tritons. Some information is also obtained on the magnitude of proton and neutron densities for these 2^+ states. (auth)

6986 POLARIZATION OF PROTONS DURING ELASTIC SCATTERING BY IRON ISOTOPES. Kalacheva, Z. F.; Omar, M. R.; Romanovskii, E. A.; Sadkin, Yu. A.; Sevast'yanov, A. I. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 86-87(Jan 1973). (In Russian).

The "angular distribution of proton polarization" was measured for elastic scattering by isotopes of iron at three values of energy in the interval 6.5 to 5.8 MeV. (1 figure) (tr-auth)

6987 POLARIZATION OF PROTONS DURING ELASTIC SCATTERING BY ^{50,52,53,54}Cr AND ^{51}V IN THE ENERGY REGION 5.8 TO 6.5 MeV. Kalacheva, Z. F.; Omar, M. R.; Romanovskii, E. A.; Spasskaya, T. I.; Sultan, M. A.; Gubin, V. B.; Sevast'yanov, A. I.; Sadkin, Yu. A. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 88-93(Jan 1973). (In Russian).

Proton polarization was measured during elastic scattering by isotopes of Cr and V at several energy values in the interval 5.8 to 6.5 MeV. The angular distributions averaged over this interval were compared with those computed from the optical model. (3 figures, 1 table) (tr-auth)

6988 MULTI-CHANNEL STUDY OF FINE STRUCTURE OF AN ANALOGUE STATE IN ^{55}Mn. Peters, W. C. (Duke Univ., Durham, NC); Bilpuch, E. G.; Mitchell, G. E. Nucl. Phys.; A207: No. 3, 626-640(1973).

The ^{54}Cr(p,p), (p,p$_1\gamma$), and (p,γ) reactions were studied in the vicinity of the fragmented analog of the ground state of ^{55}Cr. The overall proton energy resolution was about 350 eV. The γ rays were detected with both NaI(Tl) and Ge(Li) detectors. Elastic and inelastic proton widths and partial and total γ-ray widths were measured for each of the eight fine structure states of the analog. The analog to antianalog strength was small. The width for the ground-state transition was 1.4 eV, while the width estimated from the strength of the β decay of the parent state is 0.4 eV. Correlations were observed between the fine structure widths in the p,p$_1$ and γ_0 channels, indicating that the analog is a common doorway for these channels. Strong correlations were also observed among the γ-ray channels. (6 figures, 3 tables) (auth)

6989 SPIN ASSIGNMENTS IN ^{59}Ni FROM THE ^{58}Ni(d,vector, p)^{59}Ni REACTION. Aymar, J. A.; Hiddleston, H. R.; Darden, S. E.; Rollefson, A. A. (Univ. of Notre Dame, IN). Nucl. Phys.; A207: No. 3, 596-608(1973).

Angular distributions of the vector analyzing power and the absolute cross section were measured for the ^{58}Ni(d,p)^{59}Ni reaction at a deuteron energy of 10 MeV. The observed j dependence of the vector analyzing power allowed unambiguous spin assignments for the following states in ^{59}Ni (with excitation energies in MeV): 0.0, $^{3}/_{2}{}^{-}$; 0.341, $^{5}/_{2}{}^{-}$; 0.465, $^{1}/_{2}{}^{-}$; 0.879, $^{3}/_{2}{}^{-}$; 1.303, $^{1}/_{2}{}^{-}$; 1.686, $^{5}/_{2}{}^{-}$; 3.454, $^{3}/_{2}{}^{-}$; 3.858, $^{3}/_{2}{}^{-}$; 4.495, $^{5}/_{2}{}^{+}$. The data are well reproduced by DWBA calculations employing deuteron and proton optical model parameters obtained from analyses of elastic scattering cross sections and polarizations. A tentative spin assignment of $^{9}/_{2}{}^{+}$ is made for the level at 3.061 MeV. A $^{5}/_{2}{}^{+}$ assignment to the level at 3.538 MeV is suggested on the basis of the empirical behavior of the j dependence of the vector analyzing power for l = 2 transitions. Measurements of the vector analyzing power for the four low-lying ^{59}Ni states formed by l = 1 transfer were made for angles from 2.5° to 15° by using a magnetic spectrograph. A very strong j dependence was observed for these far-forward-angle measurements, in agreement with DWBA predictions. (8 figures, 1 table) (auth)

6990 INTERFERENCE OF COULOMB AND NUCLEAR EXCITATION IN THE SCATTERING OF ^{16}O FROM ^{58}Ni, ^{88}Sr, AND ^{142}Nd. Christensen, P. R.; Chernov, I.; Gross, E. E.; Stokstad, R.; Videbaek, F. (Univ. of Copenhagen). Nucl. Phys.; A207. No. 3, 433-455(1973).

The interference of Coulomb and nuclear excitation was studied for ^{16}O ions bombarding targets of ^{58}Ni, ^{88}Sr, and ^{142}Nd in the energy region spanning the Coulomb barrier. The measurements include elastic and inelastic (to the first 2^+ state) excitation functions at 175° lab for all targets, excitation functions at 60°, 75°, and 90° lab for ^{58}Ni and ^{88}Sr, angular distributions at 44, 50, and 60 MeV for ^{58}Ni, and angular distributions at 52 and 60 MeV for ^{88}Sr. From the sub-Coulomb data, B(E2) values (in units of $e^2 \cdot b^2$) of 0.066 ± 0.004 for ^{58}Ni (1.45 MeV), 0.114 ± 0.015 for ^{88}Sr (1.84 MeV), and 0.27 ± 0.03 for ^{142}Nd (1.57 MeV) were obtained. The cross section data can be well reproduced by the optical model and the distorted-wave Born approximation with a collective model form factor for nuclear excitation. Absolute values for the real part of the optical-model potential are obtained for the interaction of ^{16}O and ^{58}Ni in the region 1 fm to 3 fm beyond the nuclear surface. For $r_0 = 1.3$ fm, the DWBA fits to the data require $r'_0 > r_0$, $a' < a$ and nuclear deformation parameters, $(\beta R)_{nucl}$., of 0.94 fm, 0.64 fm, and 0.34 fm for ^{58}Ni, ^{88}Sr, and ^{142}Nd, respectively. (19 figures, 3 tables) (auth)

6991 EVIDENCE FOR $f_{7/2}$ NEUTRON HOLES IN THE GROUND-STATE CONFIGURATION OF ^{58}Ni FROM THE ^{58}Ni(d,p) REACTION. Chowdhury, M. S.; Sen Gupta, H. M. (Univ. of Dacca, Pakistan). Lett. Nuovo Cim.; 6: No. 14, 587-592(7 Apr 1973).

An attempt was made to make a quantitative estimate of the vacancy in the $f_{7/2}$ neutron shell in the ground-state configuration of ^{58}Ni. An enriched target 100 μg/cm^2 thick was bombarded with 10-MeV deuterons. The emitted particles were momentum analyzed in a multigap magnetic spectrograph and detected in nuclear emulsions. A nonlocal, finite-range DWBA analysis of the differential cross sections was made. Several l = 3 transitions were observed, only two of which corresponded to a $^{5}/_{2}{}^{-}$ state. The remaining transitions were weak; and the angular distributions had a spread-out structure at the main stripping peak, not usual for a stripping distribution. The DWBA fit was not very satisfactory beyond the main peak. The distributions also showed characteristics of $f_{7/2}$ states. Spectroscopic factors and spin–parity assignments for levels in ^{59}Ni are tabulated, and some of the levels are discussed in detail. The summed spectroscopic transition strength for all these levels is found to be 1.08; this should be a measure of the vacancy in the 1$f_{7/2}$ neutron shell in the ground-state configuration of ^{58}Ni. The vacancy is found to be ~14%, subject to the usual 30% error in DWBA calculations. (1 figure, 3 tables) (RWR)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 6978, 6989, 6990, 6991, 7000, 7008, 7013, 7088, and 7093.

6992 (AERE-PR/NP-18, p 41) MEASUREMENT OF COMPOUND NUCLEAR LIFETIMES IN THE 10^{-16} TO 10^{-18} SECOND RANGE USING A BLOCKING TECHNIQUE. Clark, G. J.; Poate, J. M. Mar 1972.

6993 (COO–1505-59) DEEXCITATION PROCESSES IN NUCLEAR REACTIONS. Progress Report, May 1, 1972 – April 30, 1973. Porile, N. T. (Purdue Univ., Lafayette, Ind. Dept. of Chemistry). May 1973. Contract AT(11-1)-1505. 21p. Dep. NTIS $3.00.

Preliminary results were obtained for the spallation of silver by 300-GeV protons. The weighted average value of $\sigma_{300}/\sigma_{11.5}$ is 0.89 ± 0.08 on the basis of 19 individual cross sections; this ratio appears to be independent of product mass number. The charge distribution and recoil properties at A = 131 from the interaction of gold with 11.5-GeV protons are being determined. It was found that, as opposed to the uranium case, fission does not significantly contribute to the yield of the neutron-deficient products. The energy spectra of protons and α-particles emitted in the decay of ^{56}Fe, ^{60}Ni, ^{63}Cu, ^{64}Zn, and ^{66}Zn compound nuclei produced in reactions induced by protons and α particles have been measured. Comparison of the α and np exit channels permits a test of the independence hypothesis, and the latter is confirmed in all 5 cases. Comparison of the α and p exit channels shows that isospin conservation is of importance and permits the determination of the isospin mixing fraction, μ, the value of which is 0.4 ± 0.2 for all 5 compound nuclei. The highly excited levels of ^{63}Cu and ^{65}Cu are being populated in 4 different compound nuclear reactions at several bombarding energies to determine if all reactions are consistent with a given set of level density parameters. (2 figures, 2 tables) (auth)

6994 (INS-J-140) 3^+ STATE IN EVEN-EVEN MEDIUM SOFT NUCLEI. Sakai, M. (Tokyo Univ. (Japan). Inst. for Nuclear Study). 15 Mar 1973. 30p. (CONF-730123-1). Dep. NTIS (U. S. Sales Only) $3.50.

From twenty-third national conference on nuclear structure and atomic nuclei; Tbilisi, USSR (28 Jan 1973).

This 3^+ state has been considered as a member of the three-phonon states; however, as it always appears in pairs with the second 2^+ state in almost all nuclear regions, one can consider both states to form a collective band similar to the γ band in the deformed nuclei and refer to it as the quasi-gamma band. The experimental equipment and techniques used in 3^+ state hunting are described first: particular aspects considered are excitation functions, the angular distribution, and conversion electron measurements. The (p,xn) reaction at 21 MeV was used to obtain data, and gamma spectra are shown for targets of ^{75}As, ^{79}Br, ^{81}Br, ^{85}Rb, and ^{121}Sb. The resultant energy-level schemes are given for ^{74}Se, ^{78,80}Kr, ^{84}Sr, and ^{119,120}Te. The energy systematics of 2^+ and 3^+ states are examined. Finally, the nuclear properties of the 3^+ states are discussed from the point of view of quasi-gamma band and in terms of the Davydov-Chaban model. A procedure is outlined which provides a clue to understanding of the nuclear structure of the soft (quasi-deformed) nuclei through the location of the 3^+ state. The importance of the quasi-K quantum number is treated. In summary, the quasi-gamma band explains more naturally the low-lying level system of the soft nuclei than the vibrational model, and the location of the 3^+ state sensitively depends on the nuclear properties through the Davydov-Chaban model. The special character of the 3^+ state is that it appears in rather pure form, so that quasi-K is a good quantum number. This manifests itself in lower than usual values of log ft, as illustrated for ten nuclei with A = 72 to 136; it is especially prominent for ^{96}Tc and ^{136}Pr. (22 figures, 1 table) (RWR)

6995 ENERGY LEVELS OF ^{94}Ru OBSERVED WITH THE ^{96}Ru(p,t) REACTION. Ball, J. B. (Oak Ridge National Lab., TN); Fulmer, C. B.; Larsen, J. S.; Sletten, G. Nucl. Phys., A; A207: No. 2, 425-432(1973).

The level structure of the neutron-magic nucleus ^{94}Ru, up to an excitation energy of 4 MeV, was studied by means of the (p,t) reaction. Particular emphasis was placed on a search for excited 0^+ levels, none of which have been reported previously. Among new levels observed in this study are 0^+ levels at 2.995, 3.615, and 3.770 MeV, and the 3^- octupole vibration at 2.965 MeV. (auth)

6996 LIFETIMES AND DECAYS OF ENERGY LEVELS IN ^{60}Ni. Ronsin, H.; Beuzit, P.; Delaunay, J.; Ballini, R.; Fodor, I.; Fouan, J. P. (CEN de Saclay, Gif-sur Yvette, France). Nucl. Phys.; A207: No. 3, 577-595(1973).

The Doppler-shift-attenuation technique was used to investigate the lifetimes of 33 states of ^{60}Ni up to 5.6 MeV of excitation; 18 were measured for the first time. Gamma rays from the ^{60}Ni(p, p′γ) reaction were observed in coincidence with protons by two Ge(Li) detectors at 40° and 130° lab. A new doublet (3.381-3.393 MeV) was found. Several previously unknown γ-ray branching ratios are given, the lifetimes allow one to attribute some spins or parities or to reject other assignments. In order to complement the existing information on ^{60}Ni, the proton configuration was studied by the ^{59}Co(^{3}He,dγ) reaction. The results are different from those expected from simple 1p-1h states of the proton core; many of the levels observed are multiplets decaying by cascades. (3 figures, 4 tables) (auth)

6997 DECAY OF ^{77}Kr. Baskova, K. A.; Vasil'ev, S. S.; Mokhsen, M. A.; Chugai, T. V.; Shavtvalov, L. Ya. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 73-76(Jan 1973). (In Russian).

The γ spectrum and $\beta-\gamma$ and $\gamma-\beta$ coincidences for ^{77}Kr were studied. Improvements were introduced into the ^{77}Kr decay scheme, and a series of new levels was added. (1 figure, 1 table) (tr-auth)

Nuclear Properties and Reactions, $90 \leq A \leq 149$

Refer also to abstracts 6738, 6990, 6993, 6994, 7015, 7031, 7032, 7084, 7093, and 7096.

6998 (AD-752621) INVESTIGATION OF LONGITUDINAL POLARIZATION AND OTHER PROPERTIES OF SOME β-TRANSITIONS. Final Report, 5 October 1966-31 January 1971. Sastry, K. S. R. (Massachusetts Univ., Amherst. Dept. of Physics and Astronomy). 1972. Contract DAHC04-70-C-0064. 65p. NTIS.

Several hindered allowed β transitions and forbidden decays were investigated through β-ray longitudinal polarization, $\beta-\gamma$ correlations, and β-shape factor studies. The results are presented and their significance is examined. No evidence is found, within experimental limits, for significant contributions of higher-order effects in hindered allowed β decay with moderate energy release. Considerable success is achieved in understanding properties of several forbidden β transitions in terms of meaningful nuclear models and expectations based on current theory of weak interactions. Studies of influence of multiple scattering of electrons on angular correlations are reported. (auth) (NTIS)

6999 (BNL-tr-537) DIFFERENTIAL CROSS SECTIONS AND ANGULAR DISTRIBUTIONS OF γ RAYS FROM THE (n,n′γ) REACTION OF ^{141}Pr AND ^{165}Ho. Andreev, E. A.; Sit'ko, S. P.; Shevchenko, V. A. Translated by S. J. Amoretty from Yadern. Fiz.; 15: No. 5, 856-859(1972). 11p. Dep. NTIS $3.00.

The angular distributions and differential cross sections of γ rays from (n,n′γ) reactions on ^{141}Pr and ^{165}Ho were measured. Some new γ transitions from the excited states of Pr and Ho were found, in the region of excitation energies more than 1.0 MeV. The spins of the corresponding levels of these nuclei were determined by the comparison of the experimental data and theoretical calculations based on Satchler theory. (auth)

7000 (WAPD-TM-1073) TOTAL CROSS SECTION MEASUREMENTS WITH A ^{252}Cf TIME-OF-FLIGHT SPECTROMETER. LWBR Development Program. Green, L.; Mitchell, J. A. (Westinghouse Electric Corp., Pittsburgh, PA. Bettis Atomic Power Div). Apr 1973. Contract AT-11-1-Gen-14. 29p. Dep. NTIS $3.50.

A time-of-flight spectrometer employing a 1-microgram sample of ^{252}Cf as a neutron source was used to obtain total cross section data by transmission measurements in the energy interval 0.5 to 10 MeV. The source was contained in a thin-walled gas scintillator cell with the time-zero mark provided by the fission flash. The neutrons were detected after tranversing a 3.7-meter flight path by a 5-inch diameter by 2-inch long liquid scintillator (NE-213). Pulse shape discrimination was employed to reduce background and eliminate the effect of delayed fission γ-rays. With a source intensity of 6×10^5 fissions/second, 3 percent statistics or better in cross section were obtained over most of the energy range after about 24 hours of operation. Drift effects were minimized by frequent recycling of the targets. Data are presented for carbon, thorium, lead, niobium, hafnium, cadmium, zirconium (Zircaloy-II), ^{90}Zr, ^{92}Zr, chromium, nickel, ^{233}U, and ^{235}U. Where possible, the results are compared with the ENDF/B-II evaluations. (19 figures, 1 table) (auth)

7001 COHERENT $\pi^- \rightarrow \pi^-\pi^0$ PROCESS AT MOMENTUM 3.3 GeV/c ON XENON NUCLEI. Vorob'ev, I. I.; Novikov, L. S.; Shishov, N. N. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 17: No. 3, 547-550(Mar 1973). (In Russian).

The $\pi^- + Xe \rightarrow \pi^- + \pi^0 + Xe$ reaction at π^--meson initial momentum 3.3 GeV/c was searched for in the region of the momentum transferred to nucleus <50 MeV/c. The cross section was found to be $\leq$143 μbn with 90% confidence level. (auth)

7002 MEASURING COINCIDENCES BETWEEN POSITRONS AND DELAYED PROTONS FOR ^{109}Te. Bogdanov, D. D.; Karnaukhov, V. A.; Petrov, L. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 3, 457-462(Mar 1973). (In Russian).

For ^{109}Te, produced in ^{96}Ru(^{16}O, 3n) reaction the spectrum of delayed protons was measured in coincidence with positrons and without it. The ratio of two spectra was compared with the calculated energy function, which is determined by relative probabilities of positron emission and electron capturing in transition of ^{109}Te into proton-unstable states ^{109}Sb. From condition of the best agreement it was found that $Q_0 - B_p = 7.14 \pm 0.10$ MeV, where Q_0 - is K capture energy of ^{109}Te, B_p is binding energy in ^{109}Sb. (auth)

7003 NUCLEAR ROTATIONAL ANOMALY AND THE HFB EQUATIONS. Bhargava, P. C. (Univ. of Birmingham, Eng.). Nucl. Phys.; A207: No. 2, 258-272(1973).

It is shown that the S-shape of the plot of moment of inertia versus square of the angular frequency observed experimentally for the rotational spectrum of rare-earth nuclei follows naturally from the solution of the Hartree-Fock-Bogoliubov equations. The case of eight particles in the $1\,h_{11/2}$ level outside a closed shell is considered and the Sussex interaction is used for the nucleon-nucleon potential. Some properties of the upper, middle, and lower branches are looked into and it is established that the transition indeed occurs due to reduction in the strength of the pairing part of the interaction due to the Coriolis force. Methods for calculating the moment of inertia and other nuclear properties in the transitional region, i.e., the middle branch, are suggested and it is found that the properties there are intermediate between the upper and lower branch. The importance of higher (> 0) particle-particle channel coupled angular momentum of the nucleon force for the rotational spectrum of deformed nuclei at high angular momentum is also suggested. A comment is also made on misleading results that can be obtained for e.g. moment of inertia, by projecting only even integral values of angular momentum in Hartree-Fock type solutions and thereby ignoring finer details. (auth)

7004 $\gamma\gamma$-ANGULAR CORRELATIONS IN ^{115}In. Badica, T.; Gelberg, A.; Dima, S.; Popescu, I.; Chortea, C. (Inst. for Atomic Physics, Bucharest). Yadern. Fiz.; 17: No. 4, 665-669(Apr 1973). (In Russian).

Angular correlation measurements of the transitions in ^{115}In were carried out with Si(Li), Ge(Li) and scintillation detectors. The spin $\frac{1}{2}$ was determined for 864 keV level. (auth)

7005 POSSIBILITIES OF ELECTROMAGNETIC TRANSITIONS IN ^{132}La AND ^{133}La NUCLEI. Morozov, V. A.; Muminov, T. M.; Fuya, Kh.; Khalikulov, A. B. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 4, 670-677(Apr 1973). (In Russian).

The lifetimes of levels 182 keV ($T_{1/2}$ = 0.83 ± 0.11 nsec) of ^{132}La, 97 keV ($T_{1/2}$ < 0.4 nsec), 130 keV ($T_{1/2}$ = 1.12 ± 0.18 nsec), 174 keV ($T_{1/2}$ = 0.83 ± 0.18 nsec) and 742 keV ($T_{1/2}$ = 1.30 ± 0.10 nsec) of ^{133}La are measured by the $e\gamma$ delayed coincidence method. The lifetimes of levels 182 keV of ^{132}La, 174 and 742 keV of ^{133}La are measured for the first time. (auth)

7006 MEASUREMENT OF THE STATIC QUADRUPOLE MOMENTS OF THE FIRST 2^+ STATES OF ^{102,104}Ru. Nolan, M. F.; Hall, I.; Thomas, D. J.; Throop, M. J. (Univ. of Liverpool). J. Phys., A (London); 6: No. 5, L57-L59(May 1973).

The static quadrupole moments of the first excited states of ^{102}Ru and ^{104}Ru have been measured by Coulomb excitation. Both are negative, the ^{104}Ru moment being the larger and of approximately the magnitude given by the rotational model. (auth)

7007 DECAY OF ^{148}Tb AND ^{150}Tb. Part II. $\gamma-\gamma$ Coincidence Spectra. Decay Scheme of ^{148}Tb and ^{150}Tb. Vylov, Ts.; Gromov, K. Ya.; Gromova, I. I.; Iskhakov, G. I.; Kuznetsov, V. V.; Kuznetsova, M. Ya.; Potempa, A. V.; Fominykh, M. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 48-52(Jan 1973). (In Russian).

The $\gamma-\gamma$ coincidence spectra of ^{148}Tb and ^{150}Tb were studied using two Ge(Li) detectors and a two-dimensional analyzer. Decay schemes were constructed for these two isotopes based on the results of γ-ray spectra, conversion-electron spectra, and $\gamma-\gamma$ coincidences. A comparison is made of analogous excited states in ^{148}Gd and ^{150}Gd and the neighboring nuclei of Sm and Nd. (5 figures, 2 tables) (KSW)

7008 DECAY OF HIGHLY-EXCITED COMPOUND SYSTEMS WITH LARGE ANGULAR MOMENTA. Avdeichikov, V. V.; Lozhkin, O. V.; Perfilov, N. A. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 143-153(Jan 1973). (In Russian).

Results are presented from an experimental investigation of the kinematic characteristics of the isotopes ^{1,2,3}H and ^{4}He which are formed during the decay of compound systems in the reactions: ^{22}Ne + Ni, Nb, Ag, and Au at an ion energy of 175.4 MeV. (7 figures, 2 tables) (tr-auth)

7009 MEASUREMENTS OF THE $\beta-\gamma$ ANGULAR CORRELATIONS FOR SOME β TRANSITIONS OF ^{48}V, ^{131}I, AND ^{147}Nd. Subotovich, M.; Budzynski, M.; Koznevska, E.; Ptashek, I.; Sarzhinski, Ya. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 154-155(Jan 1973). (In Russian).

The asymmetry coefficients A_2 of the $\beta-\gamma$ angular correlation functions were measured for the β transitions ^{48}V → ^{48}Ti, ^{131}I → ^{131}Xe, and ^{147}Nd → ^{147}Pm. (tr-auth)

7010 DECAY OF ^{131}Ce. Deleplanque, M. A.; Gerschel, C.; Perrin, N. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys.; A207: No. 3, 565-576(1973). (In French).

A partial level scheme for the nucleus ^{131}La is deduced from radioactivity measurements. The weak (K,β^+) feeding of low-energy levels is interpreted. The importance of Coriolis effects in this nucleus is discussed. (5 figures, 1 table) (auth)

7011 DECAY OF ^{148}Tb AND ^{150}Tb. Part I. Spectra of the Conversion Electrons and γ Rays. Vylow, Ts.; Gromov, K. Ya.; Gromova, I. I.; Iskhakov, G. I.; Kuznetsov, V. V.; Kuznetsova, M. Ya.; Potempa, A. V.; Fominykh, M. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 43-47(Jan 1973). (In Russian).

The spectra of γ rays, conversion electrons, and $\gamma-\gamma$ coincidences of ^{148}Tb and ^{150}Tb were studied. The halflife of ^{150}Tb was 3.48 ± 0.16 hours. Decay schemes were proposed for ^{148}Tb → ^{148}Gd and ^{150}Tb → ^{150}Gd. A comparison was made of the excited states of the neighboring nuclei ^{148}Gd, ^{146}Sm, ^{144}Nd, ^{150}Gd, ^{148}Sm, ^{146}Nd. (4 tables) (tr-auth)

7012 GUIDE TO NUCLEAR PHYSICS. Booty, B. London; Peter Peregrinus Ltd. (1972). 161p.

The subject is covered in chapters: the atom (atomic structure); the nucleus (nuclear structure and properties); nuclear energy; nuclear reactions; nuclear fission and chain reactions; nuclear reactors; radiation detection (and radiation detectors); research machines and techniques (the mass spectrograph, particle accelerators, machines in neutron physics). (UK)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 6978, 6999, 7000, 7003, 7007, and 7011.

7013 (AERE-PR/NP-18) NUCLEAR PHYSICS DIVISION PROGRESS REPORT FOR THE PERIOD 1st MAY 1970 TO 30th APRIL 1971. Uttley, C. A.; Blair, I. M. (eds.) (Atomic Energy Research Establishment, Harwell (England)). Mar 1972. 120p. Dep. NTIS (U. S. Sales Only) $8.00.

The sections of this report are divided into the following categories: General reactor technologies and studies (nuclear data for fast reactors, neutron cross section evaluation); General nuclear data for reactors; Fundamental and basic research: Nuclear structure and dynamics; Miscellaneous studies in physics; Miscellaneous technologies and techniques; Industrial physics and radioisotope research; Accelerator operation, maintenance, and development; and Reports, publications, and conference papers. (RWR)

For abstracts of individual papers see: 5087, 5604, 5803, 6624, 6696, 6760, 6932, 6936–6939, 6946–6951, 6992, 7014, 7015, and 7041–7043.

7014 (AERE-PR/NP-18, pp 4-6) NEUTRON CAPTURE AND TOTAL CROSS SECTION MEASUREMENTS. Axmann, H. P. (Univ. of Vienna); Endacott, D. A. J.; Jolly, J. E.; Moxon, M. C. Mar 1972.

7015 (AERE-PR/NP-18, pp 23-27) RESONANCE CAPTURE GAMMA-RAY STUDIES. Thomas, B. W.; Axmann, H. P.; Riehs, P.; Rae, E. R. Mar 1972.

7016 (FRNC-TH–355) SEARCH FOR COLLECTIVE TYPE EXCITED STATES IN ^{184}Pt, ^{186}Pt, ^{188}Pt, ^{190}Pt, ^{192}Pt AND ^{182}Os, ^{184}Os AND ^{186}Os NUCLEI. Husson, J. P. (Paris Univ. (France)). 1972. 112p. (In French). Dep. NTIS (U. S. Sales Only) $7.75. Thesis.

An on-line and a semi on-line spectroscopic study of even–even nuclei between ^{184}Pt and ^{192}Pt and ^{182}Os and ^{186}Os enabled knowledge about the low-energy (E < 2.0 MeV) collective levels of these nuclei to be completed. The experimental results were compared with theoretical predictions. It was found that the properties of transition nuclei in the Pt–Os region are not explainable in terms of a fixed-form potential having spherical or axial symmetry. The ^{182}Os and ^{184}Os nuclei appear to be well explained by phenomenological models with rotation–vibration interaction. In nuclei lying between ^{184}Pt and ^{192}Pt, large variations in the energy of the collective levels with crossing of the $2_2^+-4_1^+$ excited states and mixing of the β and γ quasi-bands in each nucleus are observed. The reduced transition probabilities also vary considerably. The values obtained for the deformation parameters correspond to the mean values (the spreading out of the wave functions of the states is considered). The inversion of the position of the $2_2^+-4_1^+$ states is linked to the sign of the theoretical cigar–disk energy difference, the sign change corresponding to a transition which was predicted and verified for ^{190}Os and ^{192}Os. Studies of the potential energy surface enabled the determination of nuclei capable of shape transitions: ^{186}Pt and ^{188}Pt (Kumar model) and ^{190}Pt and ^{192}Pt (Nilsson model). The hypothesis of the separation of quasi-particle excitations and collective states is well justified for Pt isotopes having atomic numbers in the A = 186 region. The differences between the theoretical and experimental values may be due to the collective modes not taken into account by the various models. (FR)

7017 (ORNL–4803) TUNGSTEN NEUTRON ELASTIC- AND INELASTIC-SCATTERING CROSS SECTIONS FROM 4.34 TO 8.56 MeV. Kinney, W. E.; Perey, F. G. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 39p. Dep. NTIS $4.00.

Measured natural tungsten neutron elastic- and inelastic-scattering cross sections are presented and shown to be in good agreement with the results of the others. An evaporation model of inelastic scattering was found to be applicable with nuclear temperatures in agreement with previous results but with total inelastic-scattering cross sections larger by as much as 20% than measured nonelastic-scattering cross sections. ENDF/B W (Mat 1060-63) elastic-scattering angular distributions agree with these data at angles less than 50° but do not at larger angles. The ENDF/B nuclear temperatures are 10 to 15% lower than experimental temperatures. (7 figures, 2 tables) (auth)

7018 GIANT DIPOLE RESONANCE IN NUCLEI OF THE TRANSITION REGION A APPROX. 190. Goryachev, A. M.; Zalesnyi, G. N.; Semenko, S. F.; Tulupov, B. A. (Saratov State Univ., USSR). Yadern. Fiz.; 17: No. 3, 463-469(Mar 1973). (In Russian).

Cross sections for photoneutron reactions were measured in the region of giant dipole resonance on ^{184,186}W, ^{190}Os and ^{185,187}Re isotopes. The measurements were made in the photon energy range 7 to 20 MeV with 0.2 MeV step. Neutrons were detected by detectors with 21% efficiency for neutrons of ^{252}Cf fission. A correction was made for dependence of detection efficiency upon neutron energy. The measured curves of yield were handled by the computer with a special program for dumping out the failures and for obtaining the resulting curve of yield with its RMS errors and quantities, characterizing stability of measuring apparatus. Qualitative comparison of the obtained results with predictions of the model of dipole and quadrupole oscillation coupling was carried out. (auth)

7019 LIFETIMES OF ROTATIONAL STATES IN ^{164}Yb AND ^{162}Yb. Bochev, B.; Karamyan, S. A.; Kutsarova, T.; Nadzhakov, E.; Venkova, Ts.; Kalpakchieva, R. (Joint Inst. for Nuclear Research, Moscow). Phys. Scr.; 6: No. 5-6, 243-246(1972).

The lifetimes of several transitions in the ground-state rotational bands (g.s.r.b.) of ^{164}Yb and ^{162}Yb have been measured. The (^{40}Ar,4n) reaction has been used; and the recoil-distance Doppler-shift method employed. The deduced B(E2) values are compared with those of the rigid-rotor model. The quadrupole moments and deformation parameters are determined.

7020 G-FACTOR OF THE 6^+ ROTATIONAL STATE IN ^{166}Er. Carlsson, G.; Karlsson, E.; Pernestaal, K.; Waeppling, R. (Uppsala Univ.). Phys. Scr.; 6: No. 5-6, 247-250(1972).

The PAC-method has been applied to two $\gamma-\gamma$ cascades in ^{166}Er, one of them involving the 4^+ state and the other, the 6^+ state of the ground state rotational band. The $\gamma-\gamma$ cascades were emitted in the decay of ^{166m}Ho. To obtain a high effective hyperfine field the source was kept in the form of $HoAl_2$, which forms a suitable environment for studying magnetic perturbations for states with lifetimes in the $10^{-11}-10^{-10}$ s range. $HoAl_2$ is paramagnetic above ~30 K; and the experiment on both levels was performed at 51 K, where the paramagnetic amplification factor β (in $B_{eff} = \beta B_{ext}$) is of the order of 40, while the electronic relaxation in the 4f-shell of Er^{3+} still is fast enough to ensure thermal equilibrium after the element transformation even for the 6^+ state. The experiment was run at an external field, $B_{ext} = 30$ kG, and the precessions in the effective field could be determined with accuracies of the order of 10–15%. From the ratio $(\omega\tau)_6^\dagger/(\omega\tau)_4^\dagger$ we deduce $(g\tau_N)_6^\dagger/(g\tau_N)_4^\dagger =$ 0.136(16), and using the known values of $g_4^\dagger = 0.266(24)$, $\tau_4^\dagger = 174(11)$ ps we obtain $(g\tau_N)_6^\dagger = 0.63 \times 10^{-11}\ \mu_N \cdot s$. The lifetime $\tau_6^\dagger$ has not been measured directly, but using the rotational model value we obtain $g_6^\dagger = 0.27(5)$. The gyromagnetic ratios therefore seem to be constant to within 20% within the first three members of the rotational band. (SW)

7021 BACKBENDING EFFECT IN ^{158}Er, ^{160}Er, ^{164}Yb, ^{166}Yb, AND ^{168}Hf; AND SOME REMARKS ON ITS SYSTEMATICS. Davidson, W. F.; Lieder, R. M.; Beuscher, H.; Mayer-Boericke, C. (Kernforschungsanlage, Juelich, Ger.). Phys. Scr.; 6: No. 5-6, 251-254(1972).

The experimental results concerning high-spin states in the ground state rotational bands of ^{158,160}Er, ^{164,166}Yb, and ^{168}Hf are discussed with respect to the dependence of the moment of inertia on the rotational frequency. Certain systematic features and trends were found. (SW)

7022 2^+ ISOMER SHIFTS OF RARE-EARTH NUCLEI. Meyer, J.; Speth, J. (Technische Univ., Munich, Garching, Ger.). Phys. Scr.; 6: No. 5-6, 283-284(1972).

Preliminary results of a microscopic calculation of 2^+ isomer shifts are discussed briefly. (SW)

7023 NON-ADIABATIC EFFECTS IN THE ROTATIONAL MOTION OF ODD-MASS DEFORMED NUCLEI. Pyatov, N. I. (Joint Inst. for Nuclear Research, Dubna, USSR); Baznat, M. I.; Chernei, M. I. Phys. Scr.; 6: No. 5-6, 227-238(1972).

The non-adiabatic description of rotational motion in odd-mass nuclei is reviewed. The theory of renormalization of one-particle matrix elements due to residual interactions is given. Equations for calculating the effective (adiabatic) parameters of rotational states in odd-mass nuclei are developed. The analysis is given of a number of rotational bands in rare-earth nuclei. (SW)

7024 SHELL STRUCTURE EFFECTS ON THE HIGH-SPIN ROTATIONAL STATES IN YTTERBIUM NUCLEI. Hartley, A. J.; Chapman, R.; Dracoulis, G. D.; Flanagan, S.; Gelletly, W.; Mo, J. N. (Univ. of Manchester, Eng.). J. Phys., A (London); 6: No. 5, L60-L65(May 1973).

The ground state rotational band members up to spin 18^+ have been identified in ^{170}Yb(N = 100) by studying the γ rays from the ^{160}Gd(^{14}C,4n)^{170}Yb reaction. The nuclear moment of inertia of the band shows an abrupt increase at high-spin values similar to that observed in nuclei with N = 90–96, but in contrast with the smooth increase in the N = 98 nucleus ^{168}Yb. This dependence on neutron number is difficult to explain in terms of the decoupling of neutrons in the $i_{13/2}$ orbital alone, but is consistent with the Coriolis antipairing description of a phase transition from a superfluid to a normal state if account is taken of the reduction in pairing correlations caused by the shell structure peculiar to ^{168}Yb. (auth)

7025 ASYMMETRY IN THE ^{176}Yb(p,t)^{174}Yb REACTION USING POLARIZED PROTONS AT 16 MeV. Igo, G. (Univ. of California, Los Angeles); Chai, J. C. S.; Casten, R. F.; Udagawa, T.; Tamura, T. Nucl. Phys.; A207: No. 2, 289-297(1973).

The vector analyzing power, as well as the differential cross sections, were measured for the ^{176}Yb(p,t)^{174}Yb reaction with E_p = 16 MeV, leading to the 0^+, 2^+, and 4^+ states of the ground band. It was found that the CCBA explains both measurements rather well, while the DWBA also explains the data for the analyzing power, but not the (p,t) angular distributions particularly those for the excited states. (auth)

7026 ONE-NUCLEON TRANSFER REACTIONS TO QUASI-INTERSECTING LEVELS $1/2^+$[660] AND $1/2^+$[400], $3/2^+$[651] AND $3/2^+$[402]. Gareev, F. A.; Baznat, M.; Wiebicke, H. J.; Schulz, H. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 4, 761-769(Apr 1973). (In Russian).

Based on the coupled channel method, the reactions (d,t) on Gd^{160} and Dy^{164} nuclei are considered taking account of N = ±2 mixing of states $1/2^+$[660] and $1/2^+$[400], $3/2^+$[651] and $3/2^+$[402]. The results show that this kind of method allows one to give satisfactory description of the transfer reaction cross sections to these states. When including the Coriolis interaction between the states where stripping takes place, the cross sections change by 30%. (auth)

7027 FISSIONABILITY AS A FUNCTION OF ANGULAR MOMENTUM FOR ^{170}Yb COMPOUND NUCLEI EXCITED TO 107 MeV. Zebelman, A. M. New York; Columbia Univ. (1972). 94p. University Microfilms Order No. 73-9059.

Thesis (Ph. D.)..

Fission and complete fusion cross sections are presented for four entrance channels leading to ^{170}Yb compound nuclei excited to 107 MeV: ^{11}B + ^{159}Tb, ^{12}C + ^{158}Gd, ^{16}O + ^{154}Sm, and ^{20}Ne + ^{150}Nd. By using the Bohr Independence Hypothesis, the data are combined to yield an experimentally determined dependence of fission probability on angular momentum for the systems studied. The results are compared with theoretical fissionability calculations based on the Bohr–Wheeler formalism for fission widths and the Weiskopf formalism for neutron and charged-particle widths. The calculations include the effects of multiple-chance fission. The agreement found between theory and experiment when using a reasonable set of parameters tends to justify the use of the liquid-drop model in the description of the dependence of fissionability on angular momentum. (Diss. Abstr. Int., B)

7028 PROPERTIES OF THE EXCITED 0^+ STATES OF ^{170}Yb. Dzhelepov, B. S.; Shestopalova, S. A. (All-Union Scientific-Research Inst. of Metrology, Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 2-18(Jan 1973). (In Russian).

The properties of four excited states of ^{170}Yb of the 0^+ type are re-examined by the authors on the basis of more recent work. These four 0^+ states result from the decay of ^{170}Lu and are characterized by the energies 1069.36, 1228.91, 1479.91, and 1566.38 keV. The levels at 1228.91 keV (0^+) and 1306.23 keV (2^+) are considered as levels of the β band of ^{170}Yb. The levels at 1479.91 keV (0^+) and 1534.52 keV (2^+) form a rotational pair of the 0^+ two-particle state $n5/2^-[512]-n5/2^-[523]$. The level at 1069.36 keV (0^+) possesses a rare feature: its rotational level 2^+0 is one of the members of the doublet at 1138.56 keV (2^+) and 1145.65 keV (2^+). The levels at 1566.38 keV (0^+) and 1634.80 keV (2^+) apparently are rotational companions of the 0^+ two-particle state $n1/2^-[510]-$ $n1/2$-[521]. (2 figures, 1 table) (KSW)

7029 DECAY SCHEME OF ^{162}Ho. Baskova, K. A.; Vasil'ev, S. S.; Grigor'ev, E. P.; Morsi, M. A.; Chugai, T. V. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; No. 1, 68-72(Jan 1973). (In Russian).

The γ spectrum of ^{162}Ho was measured with a Ge(Li) detector. New γ transitions were discovered with $E_\gamma = 540$, 1669, 1699, 1737, and 1781 keV. A decay scheme was constructed for ^{162}Ho. (1 figure, 1 table) (tr-auth)

7030 INTENSITY OF THE ISOMERIC TRANSITION OF ^{154}Tb. Bak, L. M.; Nedovesov, V. G.; Khol'nov, Yu. V.; Shchukin, G. E. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 38-42(Jan 1973). (In Russian).

The relative change with respect to time of the total intensity of the 2063.8- and 2186.7-keV γ transitions was measured; the change reflected the change in activity of the ^{154}Tb isomer with $I = 0$. The measurements were conducted with Ge(Li) detectors with volumes of 8, 22, 36, and 40 cm^3. The ^{154}Tb was obtained by proton bombardment of Ta in a synchrocyclotron. (1 figure) (KSW)

7031 INFLUENCE OF NUCLEAR ROTATION ON THE MOMENT OF INERTIA IN ^{160}Er AND ^{156}Dy. Ryde, H. (Institut des Sciences Nucleaires, Grenoble, France); Hjorth, S. A.; Barneoud, D.; Johnson, A.; Hagemann, G. B.; Herskind, B. (Institut des Sciences Nucleaires, Grenoble, France). Nucl. Phys.; A207: No. 3, 513-526(1973).

High-spin members of the ground-state rotational bands in ^{156}Dy and ^{160}Er were populated in compound-nucleus reactions induced by helium and oxygen ions. For ^{156}Dy the deduced nuclear moment of inertia starts to increase very rapidly with spin at a spin value of 16. For ^{160}Er the corresponding increase of the moment of inertia around spin 14 is so abrupt that the rotational angular velocity temporarily decreases. The possibility of making qualitative predictions of the properties of the moment of inertia at high-spin values from its behavior at low-spin values is also discussed. (7 figures, 4 tables) (auth)

7032 ANGULAR VELOCITY EXPANSIONS OF NUCLEAR ROTATIONAL ENERGIES. Saethre, O. (NORDITA, Copenhagen); Hjorth, S. A.; Johnson, A.; Jaegare, S.; Ryde, H.; Szymanski, Z. Nucl. Phys.; A207: No. 3, 486-512(1973).

A phenomenological expansion of nuclear rotational energies in terms of the angular velocity is discussed and applied to the doubly even nuclides in the mass region between Ce and Pt. The results of fits with two, three, and four parameters are presented. The two-parameter angular velocity expansion is equivalent to the VMI (variable moment of inertia) model, and gives a remarkably improved description of rotational energies as compared to, for instance, expansions in terms of $I(I + 1)$. An increase in the number of parameters from two to three has a relatively small influence on the quality of the fits. However, noticeable improvement is obtained for the good rotors after the introduction of the fourth parameter. In these fits, the third and the fourth parameter are, with two exceptions, always negative and positive, respectively. The absolute magnitude of the expansion coefficients exhibit several correlations. The rotational spectra of many doubly even nuclides were measured or remeasured in connection with the present investigation. (2 figures, 4 tables) (auth)

7033 FAST-NEUTRON TRANSMISSION THROUGH A POLARIZED HOLMIUM TARGET. Fasoli, U.; Galeazzi, G.; Toniolo, D.; Zago, G. (Istituto Nazionale di Fisica Nucleare, Padua). Lett. Nuovo Cim.; 6: No. 13, 485-490(31 Mar 1973).

A polarized Ho target was constructed, and the deformation effect of the neutron total cross section, i.e., the dependence of this cross section of deformed nuclei on the degree of nuclear orientation, was measured from 0.6 to 4.0 MeV. The polycrystalline Ho sample was cooled to (0.31 ± 0.10) °K in a magnetic field of 40 T; "warm" runs were made at 4.2°K. The deformation effect, $\Delta\sigma_{def} = \sigma(\text{oriented}) - \sigma(\text{unoriented})$, was measured by the variation of the total cross section associated with the warming-up of Ho. The results are plotted and tabulated as a function of neutron energy; the excitation function is also given. Errors vary, but are on the order of 5%. The data are compared with those of other experimenters and with theoretical predictions. (3 figures, 1 table) (RWR)

Nuclear Properties and Reactions, $190 \leq A \leq 219$

Refer also to abstracts 5771, 5776, 6978, 7000, 7008, 7016, 7018, 7032, and 7090.

7034 MEASURING TOTAL COEFFICIENT OF NUCLEON INELASTICITY IN INTERACTION WITH IRON NUCLEI. Azaryan, M. O.; Mamidzhanyan, E. A.; Suleimanov, R. A. (Inst. of Physics, Erevan). Yadern. Fiz.; 17: No. 3, 564-566(Mar 1973). (In Russian).

The total coefficient of nucleon inelasticity in iron was measured for energy range 0.6 to 10 TeV. Its mean value $\langle K \rangle = 0.77 \pm 0.02$. Some decrease of $\langle K \rangle$ is observed with increasing nucleon energy. (auth)

7035 INELASTICITY OF NUCLEON INTERACTION OF 1 TO 10 TeV ENERGY WITH LEAD NUCLEI. Azaryan, M. O.; Mamidzhanyan, E. A. (Inst. of Physics, Erevan). Yadern. Fiz.; 17: No. 3, 561-563(Mar 1973). (In Russian)

Partial and total coefficient of nucleon inelasticity in interaction with lead nuclei have been measured. For nucleon energy $1 \leq E_c \leq 10$ TeV: $\langle K_{\pi^0} \rangle = 0.30 \pm 0.03$, $\langle K \rangle = 0.87 \pm 0.04$. (auth)

7036 LOW-LYING HIGH-SPIN STATES IN THE NEUTRON DEFICIENT LEAD ISOTOPES. Albouy, G.; Lagrange, J. M.; Pautrat, M.; Roulet, C.; Sergolle, H.; Vanhorenbeeck, J. (Institut de Physique Nucleaire, Orsay, France). Phys. Scr.; 6: No. 5-6, 219-221(1972).

The even lead isotopes with mass number $A = 200$ to $A = 194$ were produced by (HI,xn) reactions; and the de-excitation γ cascades, studied. Evidence was found for new experimental levels. Among these, the low-lying 12^+, 10^+ and 9^- states provide information which can be directly compared with the theoretical results. (auth)

7037 STUDY OF PHOTONEUTRON REACTIONS NEAR THRESHOLD. Abramov, A. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 19-24(Jan 1973). (In Russian).

A survey of data on photonuclear reactions near threshold was made, and the possibility of more extended use of this method is considered. For the reaction ^{207}Pb(γ,n)^{206}Pb the following material is presented graphically and discussed: differential cross section as a function of energy, the reaction scheme, the reaction resonance, and comparative values of Γ^0. (5 figures) (KSW)

7038 DECAY OF ^{209}At. Excited States of ^{209}Po. Part I. Spectra of γ Rays and Conversion Electrons of ^{209}At. Afanas'ev, V. P.; Vylov, Ts.; Golovkov, N. A.; Gromova, I. I.; Kolachkovski, A.; Kuznetsova, M. Ya.; Norseev, Yu. V.; Fominykh, M. I.; Fominykh, V. I.; Chumin, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 25-31(Jan 1973). (In Russian).

Gamma-ray and conversion-electron spectra of ^{209}At were investigated with semiconductor Ge(Li) and Si(Li) detectors. Internal conversion coefficients were determined, and conclusions were drawn regarding the multipole order of the series of transitions of ^{209}Po. (3 tables) (tr-auth)

7039 DECAY OF ^{209}At. Excited States of ^{209}Po. Part II. γ–γ Coincidence Spectra. The Decay Scheme for $^{209}\text{At} \rightarrow {}^{209}\text{Po}$. Afanas'ev, V. P.; Vylov, Ts.; Golovkov, N. A.; Gromova, I. I.; Kolachkovski, A.; Kuznetsova, M. Ya.; Norseev, Yu. V.; Fominykh, V. I.; Fominykh, M. I.; Chumin, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser, Fiz.; 37: No. 1, 32-37(Jan 1973). (In Russian).

The γ–γ coincidence spectra of ^{209}At were investigated with semiconductor Ge(Li) detectors. A decay scheme was proposed for $^{209}\text{At} \rightarrow {}^{209}\text{Po}$. Branching ratios for the decay of ^{209}At to ^{209}Po levels were determined, and the corresponding values of log ft were computed. (1 figure, 2 tables) (tr-auth)

7040 CROSS SECTIONS FOR PHOTONEUTRON REACTIONS WITH ^{206}Pb AND ^{208}Pb. Sorokin, Yu. I.; Khrushchev, V. A.; Yur'ev, B. A. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 156-160(Jan 1973). (In Russian).

Photoneutron reaction cross sections were measured for the lead isotopes ^{206}Pb and ^{208}Pb by using the bremsstrahlung beam of the NIIYaF betatron of Moscow State University. The integrated cross sections of the (γ,xn) reactions in the energy region up to 27 MeV were found to be 3.6 ± 0.02 and 3.96 ± 0.02 MeV·barn for ^{206}Pb and ^{208}Pb, respectively. (2 figures, 1 table) (tr-auth)

Nuclear Properties and Reactions, $A \geq 220$

Refer also to abstracts 5771 and 7000.

7041 (AERE-PR/NP-18, pp 3-4) SEARCH FOR A LONG LIFETIME ISOMERIC STATE IN ^{241}Pu AND A NEW MEASUREMENT OF THE HALF-LIFE OF GROUND STATE ^{241}Pu. Whitehead, C.; Sherwood, A. C.; Rose, B. Mar 1972.

7042 (AERE-PR/NP-18, pp 6-7) MEASUREMENT OF THE ^{235}U FISSION CROSS SECTION IN THE ENERGY RANGE

FROM 1 keV TO 1 MeV. Gayther, D. B.; Boyce, D. A. Mar 1972.

7043 (AERE-PR/NP-18, pp 7-13) NEUTRON CROSS SECTION EVALUATION. Mar 1972.

7044 (EANDC(US)-179/U) REVIEW OF THE TOTAL RADIATION WIDTHS OF THE NEUTRON RESONANCES OF ^{238}U. Rahn, F.; Havens, W. W. Jr. (Columbia Univ., New York). 1972. 14p. (INDC(US)-53/U).

An investigation was made into the present uncertainties in the total radiation widths, Γ_γ, of the fertile material ^{238}U. Recent measurements of $\langle\Gamma_\gamma\rangle$ have a wider dispersion than are required in the fast breeder reactor program. In addition, the possibility of fluctuations in Γ_γ from resonance to resonance was considered. It was concluded that the quoted uncertainties in Γ_γ are probably underestimated, and that larger statistical errors would agree better with the various published parameter sets. The best choice for $\langle\Gamma_\gamma\rangle$ was 23.55 MeV, obtained by weighting the recently reported data. Little evidence was found for a quasi-periodic structure of Γ_γ as a function of energy, with most of the variance in individual values of Γ_γ from the mean due to experimental uncertainties. (4 figures, 1 table) (auth)

7045 CHANGES OF MASS DISTRIBUTION OF FRAGMENTS FROM ^{232}Th FISSION WITH NEUTRON ENERGY. Dubrovina, M.; Novorodtseva, V. I.; Morozov, L. N.; Pchelin, V. A.; Chistyakov, L. V.; Shigin, V. A.; Shubka, V. M. (Inst. of Atomic Energy, Moscow). Yadern. Foz.; 17: No. 3, 470-474(Mar 1973). (In Russian).

The results on radiochemical measurements of the yields of a number of fragments at ^{232}Th fission by neutrons are presented. The measurements were carried out for neutron energy range from 1.5 up to 18 MeV. In the indicated interval the yield of a symmetric fission (^{115}Cd) increases from $^1/_{50,000}$ up to $^1/_7$, and the yield of "greatly asymmetric" fission (^{77}As) increases from $^1/_{1700}$ up to $^1/_{110}$ with respect to that of the most probable asymmetric fission (^{89}Sr). The yield increase correlates with the statistic parameter, determining the excitation density of the pairs of the corresponding fragments. (auth)

7046 CRITICAL CHARGE FOR COLLIDING NUCLEI. Popov, V. S. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 17: No. 3, 621-633(Mar 1973). (In Russian).

Using the approximation $(Z_1 + Z_2 - Z_c) \ll Z_c$, formulas are obtained for the critical charge in relativistic two-center problem. It allows one to find a critical distance R_c (Z_1,Z_2) between colliding nuclei at which the ground state energy of quasimolecule (Z_1,Z_2,e) reaches the boundary of the lower continuum and spontaneous production of positrons begins. (auth)

7047 ^{239}Np FISSION IN THE ^{237}Np(t,pf) REACTION. Andreev, M. F.; Gladkov, V. V.; Zavgorodnii, V. A.; Serov, V. I.; Surin, V. M. Yadern. Fiz.; 17: No. 3, 475-480(Mar 1973). (In Russian).

The results on studying ^{237}Np(t,pf) reaction at triton energy 13.30 ± 0.10 MeV are presented. Proton spectra from (t,p) and (t,pf) reactions on ^{237}Np at 125° with respect to the direction of bombarding triton beam were measured. In this fission detectors were placed at 18°, 48°, 62°, 88°, 147° and 176° with respect to the direction of fissioning nucleus motion. The fission probability for ^{239}Np within the excitation energy range 5.5 to 7.5 MeV was determined after describing angular distributions of fission fragments with a set of even Legendre polynomials with application of the least square method. With the obtained probability of ^{239}Np fission the cross section of ^{238}Np fission with 1.0, 1.5 and 1.8 MeV neutrons was calculated. (auth)

7048 BALANCE OF MASSES AND CHARGES IN FISSION AND DELAYED NEUTRONS. Maksyutenko, B. P. Yadern. Fiz.; 17: No. 3, 481-488(Mar 1973). (In Russian).

A correction for linear dependence of the most probable value of the charge upon the mass number of the fission fragments is being considered. Dependence between nucleon composition and some parameters of nucleus fission and shift of the most probable charge value is established. On these bases conclusions are made on dependence of the delayed neutron yield on energy of neutrons, which cause the fission, as well as on the charge and mass number of fissioning nuclei. (auth)

7049 FRAGMENT ANGULAR DISTRIBUTION OF SPONTANEOUSLY FISSIONING ISOMERS. Fam Zui Khien (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 3, 489-496(Mar 1973). (In Russian).

Theoretical consideration is given to a problem of angular distribution of spontaneously fissioning isomer fragments, produced in reactions with charged particles, which introduce a large angular moment into nucleus. The problem comes to investigation of the influence of particle and photon emission after production of a compound nucleus, upon the orientation of isomer spin. The influence of extranuclear perturbation upon fragment angular distribution is also considered. A possibility to determine isomer state characteristics from experimental data on fragment angular distribution is discussed. Numerical calculations of fragment angular distribution of ^{236}Pu isomer, produced in ^{235}U(α,3n) reaction are presented. (auth)

7050 NATURE OF 0^+ EXCITATIONS IN THE EVEN ACTINIDE NUCLEI. Immele, J. D. (Univ. of California, Berkeley); Struble, G. L. Lett. Nuovo Cim.; 7: No. 1, 41-47(5 May 1973).

Calculations are made for the 0^+ states for even Th, U, and Pu isotopes based on the theory of finite Fermi systems, which includes in a natural way both nonconstant pairing forces and spin dependence in the particle-hole channel. The formation is based on the assumptions that the interactions between the nucleons may be approximated by a short-ranged energy-independent interaction in both the particle-particle and particle-hole channels, and that single-particle propagators are given in the one-pole approximation. It is found that the 0_1^+ energies agree relatively well with experiment, but the two-neutron transfer data are reproduced only for ^{228}Th. In addition, the calculations predict a pair vibration with large pick-up and stripping ratios for N = 142 nuclei. (LBS)

7051 NEUTRON RESONANCE PARAMETERS OF ^{242}Pu. Poortsmans, F. (SCK-CEN, Mol, Belgium); Rohr, G.; Theobald, J. P.; Weigmann, H.; Vanpraet, G. J. Nucl. Phys.; A207: No. 2, 342-352(1973).

Capture, elastic scattering and total cross section measurements were performed on ^{242}Pu below 1300 eV. The neutron widths Γ_n were obtained for 71 resonances and the total radiative widths Γ_γ for 25 resonances. The s-wave strength function $S_0 = (0.89^{+0.10}_{-0.09}) \times 10^{-4}$ and the average radiative width $\overline{\Gamma}_\gamma = [21.9 \pm 0.4(\text{stat.}) \pm 1.0 (\text{syst.})]$. The resonance parameters were used to calculate the fission widths Γ_f from the fission cross section results of Auchampaugh et al. From these fission widths, the height of the second fission barrier is deduced: $E_B = 5.18$ MeV. (auth)

7052 PROMPT NEUTRONS FROM SPONTANEOUS FISSION OF ^{246}Cf. Dakovskii, M.; Lazarev, Yu. A.; Oganesyan, Yu. Ts.; Buklanov, G. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 4, 692-695(Apr 1973). (In Russian).

For spontaneous fission of ^{246}Cf ($\tau_{1/2}$ = 35.7 hours) the distribution of the prompt neutron multiplicity P_ν is measured, and their average number $\bar{\nu} = 3.14 \pm 0.09$ relative to $\bar{\nu} = 2.69 \pm 0.01$ for ^{244}Cm is determined. The detection efficiency of the neutron fission detector based on 36 proportional ^{3}He counters immersed in the moderator was 48.2%. ^{246}Cf was obtained from reaction ^{238}U(^{12}C,4n) on the cyclotron U-300 of the Nuclear Reactions Laboratory of the Joint Institute for Nuclear Research. (auth)

7053 YIELDS AND KINETIC ENERGIES OF FRAGMENTS AT SPONTANEOUS AND FORCED FISSION OF ^{242}Pu. D'yachenko, N. P.; Kabenin, V. N.; Kolosov, N. P.; Kuz'minov, B. D.; Sergachev, A. I. Yadern. Fiz.; 17: No. 4, 696-702(Apr 1973). (In Russian).

Yields and kinetic energies of fragments from spontaneous fission of ^{242}Pu and the fission of ^{241}Pu by thermal neutrons are measured. The difference between mean kinetic energies for spontaneous and induced fissions is found to be 2.6 ± 0.3 MeV. The yields of fragments are essentially different. (auth)

7054 NEW TWO-CENTER SHELL MODEL FOR NUCLEAR FISSION. Albrecht, K. (Univ., Frankfurt am Main). Nucl. Phys.; A207: No. 2, 225-257(1973).

A two-center single-particle potential is proposed which has the Lawrence family of liquid-drop shapes as its equipotentials. An improved parameterization of these shapes is given that facilitates their use. Only two deformation parameters are required to describe all relevant nuclear shapes for symmetric fission. These encompass Nilsson ground state shapes with ϵ and (approximately) ϵ_4 deformations, dumbbells and spheroidal fragments at large separation. The corresponding potential evolves from a deformed harmonic oscillator for the ground state of the fissioning nucleus to two deformed harmonic oscillators for well-separated fragments. In the single-particle calculation, a Thomas-type spin-orbit potential is used together with an l^2 correction term. The nuclear deformation energy is calculated by Strutinsky's prescription, including pairing energy. Results are given as deformation energy maps for the symmetric fission mode of various actinide nuclei. The asymmetric generalization of the model is outlined. (auth)

7055 ANGULAR NEUTRON DISTRIBUTION FROM TRIPLE FISSION OF ^{252}Cf. Graevskii, A. P.; Bochagov, B. A.; Chestnov, Yu. A. (Inst. of Physics, Leningrad). Yadern. Fiz.; 17: No. 4, 703-705(Apr 1973). (In Russian).

Energy spectra and yields of ^{252}Cf triple fission neutrons were measured by time-of-flight spectrometer under different angles to the direction of long-range α-particle emission. The time resolution of neutron spectrometer was determined by the γ-peak width and was found to be ±2.5 nsec. The basis of flight was 0.5 m. The angular distribution of the triple fission neutrons was considered and the contribution from each of the fragments into nucleon composition of the long-range α-particle was estimated. According to this estimate at least three nucleons of four are given by heavy fragment. (auth)

7056 ANGULAR DISTRIBUTIONS OF NEUTRONS ASSOCIATED WITH THE EMISSION OF PROTONS, TRITONS, AND α PARTICLES DURING ^{252}Cf SPONTANEOUS FISSION. Adamov, V. M.; Drapchinskii, L. V.; Kovalenko, S. S.; Petrzhak, K. A.; Pleskachevskii, L. A.; Tyutyugin, I. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 118-121(Jan 1973). (In Russian).

A direct measurement of the effect of different energy spectra of neutrons moving in and against the direction of fission α particles was made by determining the difference in the number of coincidences of α particles and neutrons moving simultaneously in a given direction or in opposite directions. The asymmetry study was extended to deuterons and tritons, using a ^{252}Cf source characterized by ~10^6 fissions/s. (2 tables) (KSW)

7057 SPONTANEOUS PRODUCTION OF POSITRONS IN COLLISIONS OF HEAVY NUCLEI. Gershtein, S. S.; Popov, V. S. (Inst. of High-Energy Physics, Serpukhov, USSR). Lett. Nuovo Cim.; 6: No. 14, 593-596(7 Apr 1973).

It is shown that the spontaneous production of positrons can take place for $Z > Z_c$ when only one of the nuclei is bare (the second one having an ordinary electron shell structure). This result suggests the feasibility of doing experiments with heavy targets instead of colliding beams. The kinematics of the collision is discussed, and appropriate wave functions are exhibited. It is found that in the K shell of the united atom there will be one vacant place, with probability $\frac{1}{2}$, and two vacancies, with probability $\frac{1}{2}$. The positron production cross section is estimated to reach 10^{-25} cm^2. In conclusion, some background effects making experimental observation of positron production difficult are considered. (RWR)

Nuclear Theory

Refer also to abstracts 5118, 6808, 6852, 6919, 6994, and 7049.

7058 (LBL–1736) RADIATIVE PION CAPTURE IN NUCLEI. Baer, H. W.; Crowe, K. M. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 15p. (CONF-730301–5). Dep. NTIS $3.00.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

The process of radiative pion capture has in recent years been shown to be a good probe of nuclear structure. The experiments and theoretical results which support this statement are reviewed. High-resolution data on the photon spectra from nuclei ranging in mass $1 \leq A \leq 209$ are shown. The observation of giant resonances in $T_z = +1$ nuclei, the quasi-free capture process, and transitions to individual bound nuclear states are discussed. The observed transition rates in 1p-shell nuclei are compared with recent shell model calculations based on an impulse-approximation Hamiltonian whose amplitudes are not adjustable constants, but are obtained from the fundamental process on the nucleon, $\pi^- + p \rightarrow n + \gamma$. The agreement is good within the limits set by the uncertainties of pionic x-ray data. Some features of radiative π capture on very light nuclei—$A = 2$, 3 and 4—are reviewed. Finally, the $\pi^- + {}^6\text{Li}\ (1^+) \rightarrow \gamma + {}^6\text{He}\ (0^+)$ transition is discussed where the PCAC hypothesis and soft-pion limit have been applied. The 1s-state radiative capture rate evaluated with these assumptions is found to agree with impulse approximation calculations and is within reasonable agreement with the recent data when corrections for 2p capture are made. (auth)

7059 (ORO–4317-20) NEW FACTORIZED OFF-SHELL PRESCRIPTION FOR THE DWIA IN KNOCKOUT REACTIONS. Technical Report No. 73-111. Redish, E. F. (Maryland Univ., College Park. Dept. of Physics and Astronomy). May 1973. 12p. Dep. NTIS $3.00.

The Distorted-Wave Impulse Approximation (DWIA) for knockout reactions, when written following a Faddeev prescription, contains a fully off-shell T matrix the arguments of which are coupled to those of the distorted waves. In order to factorize the amplitude into a distorted momentum distribution times a nucleon–nucleon amplitude, this coupling and the resultant off-shell effect is usually ignored. In this note it is shown how the off-shell T matrix may be expanded around its half-shell point, and an approximate factorized DWIA, obtained with the major off-shell effect included. The off-shell ambiguity present in the standard treatments is thereby eliminated. (1 table) (auth)

7060 SPIN DEPENDENCE OF EXCITED STATE DENSITY IN THE SUPERFLUID NUCLEAR MODEL. Ignatyuk, A. V. Yadern. Fiz.; 17: No. 3, 502-518(Mar 1973). (In Russian).

Peculiarities in applying the variation transformation of superconductivity theory when calculating nuclear state densities are considered. Differences from thermodynamics of superconductors, arising from microcanonical nature of the set of such a problem, and their influence on energy dependence of the pre-exponential multiplier of level density and spin dependence coefficient, are shown. The behaviour of the thermodynamic characteristics of the excited nucleus for arbitrary values of angular moment was studied. (auth)

7061 CALCULATION OF THE PROPERTIES OF LOW-LYING LEVELS TAKING INTO ACCOUNT MANY-QUANTA EXCITATIONS. Petrauskas, A. K.; Kamuntavichyus, G. P.; Yankauskas, K. I. (Inst. of Physics and Mathematics, Vilnyus, USSR). Yadern. Fiz.; 17: No. 3, 519-524(Mar 1973). (In Russian).

The calculation technique of the matrix elements of any translational-invariant operators for the excited $U(3(n-1))$ states with large number of quanta is proposed. The examples of calculating the energy and radii of light even–even nuclei are presented. (auth)

7062 NUCLEAR ROTATIONAL EXCITATIONS IN THE GENERALIZED DENSITY MATRIX METHOD. Belyaev, S. T.; Zelevinskii, V. G. (Inst. of Nuclear Physics, Novosibirsk, USSR). Yadern. Fiz.; 17: No. 3, 525-539(Mar 1973). (In Russian).

The method where the single particle density matrix is considered as an operator in space of collective excited states is applied in studying nuclear rotation. The microscopic transformation similar to transition into the system of intrinsic axes of unified model was found. The operator structure of equations was studied and a regular scheme for their solution was worked out. The approximation, which in the lower order gives the results of cranking model, and in the following orders–nonadiabatic effects, was considered in detail. (auth)

7063 INTRODUCING PROTON, NEUTRON, AND HYPERON COLLECTIVE DEGREES OF FREEDOM INTO THE K-HARMONICS METHOD. Gorbatov, A. M. (Kalinin State Univ., USSR). Yadern. Fiz.; 17: No. 3, 540-546(Mar 1973). (In Russian).

Correlation of neutron and proton densities in nuclei is taken into account by introducing collective variables over the particles in the framework of the hyperspherical function method. In the range of heavy nuclei the correlation effects enlarge coupling energy by tens of percent. (auth)

7064 SURFACE ENERGY OF NUCLEAR MATTER. Ho-Kim, Q.; Provencher, R. (Univ. Laval, Quebec). Nuovo Cim.; 14A: No. 4, 633-650(21 Apr 1973).

The surface energy of a semi-infinite system of nuclear matter is calculated using a two-nucleon nonlocal interaction which fits scattering data (the Tabakin interaction). The single-particle wave functions used in the description of the ground state of the system are generated by a velocity-dependent Woods–Saxon potential, whose parameters are varied to find the optimum nuclear energy and thickness. A moderately strong velocity dependence is needed. The potential energy distributes itself over the nuclear volume in a way which depends characteristically on the relative orbital angular momentum of the two-particle states. The S, P and D waves contribute in the proportion of 6.57 : 2.75 : 1 to be compared with their contributions 10.02 : 2.38 : 1 in infinite nuclear matter. (auth)

7065 BARYON POLARIZATION IN SCATTERING BY NUCLEI AT SMALL ANGLES. Lapidus, L. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 3, 592-602(Mar 1973). (In Russian).

The influence of electromagnetic interaction on polarization effects is considered for elastic scattering of nucleons and hyperons by spinless nuclei. There is discussed a possibility to determine the real part of nuclear amplitude, when studying the Wolfenstein parameters at small angles of scattering as well as creation of polarized baryon beams and obtaining the data on magnetic moments of hyperons and antibaryons. (auth)

7066 NEW DEVELOPMENT IN HIGH-ENERGY NUCLEAR COLLISIONS: SHAPES AND SHADOWS. Malecki, A. (Inst. of Nuclear Physics, Krakow). Lett. Nuovo Cim.; 6: No. 17, 699-703(28 Apr 1973).

An attempt is made to give a unified description of scattering and production in hadron collisions at high energies. The model accounts for a spatial extension of the colliding particles along the axis of collision. The case of elastic scattering of hadrons with a nucleus is considered as an example. It is shown that the model can be immediately generalized for the collision of two composite objects. (LBS)

7067 ADIABATIC PERTURBATION OF A FISSIONING NUCLEUS. Marshalkin, V. E. Yadern. Fiz.; 17: No. 3, 497-501 (Mar 1973). (In Russian).

In the framework of adiabatic perturbation theory an estimation was made for the probability of nucleon pair transition into excited states at the stage of above barrier motion behind the saddle point. It is of some tenths if crossing levels are present. Transition takes place in close vicinity of the crossing point. Transition probability is negligibly small when there are no crossing levels. (auth)

7068 NUCLEAR SHAPES, ENERGY GAPS, AND PHASE TRANSITIONS. Kumar, K. (Vanderbilt Univ., Nashville). Phys. Scr.; 6: No. 5-6, 270-282(1972).

A survey is given of our current understanding of nuclear phase transitions caused by sharp changes in nuclear shapes and energy gaps. Phase diagrams and criteria for normal–superfluid–normal and spherical–prolate–oblate–spherical phase transitions are presented. The superfluid–normal phase transition and the associated "back-bending" phenomenon observed at high spins are discussed in some detail. The constrained-Hartree–Bogolyubov treatment of the pairing-plus-quadrupole model, developed by the present author, explains the 50% increase in the moment of inertia of ^{160}Dy as J increases from 2 to 16, is capable of producing the back-bending effect, and predicts a Coriolis-Anti-Stretching effect at high spins. (SW)

7069 GIANT RESONANCES AND POLARIZATION EFFECTS. Hamamoto, I. (Technische Univ., Munich, Garching, Ger.). Phys. Scr.; 6: No. 5-6, 266-269(1972).

The properties of giant resonances and their effects on the polarizability are discussed. A comparison of the theoretical estimates with available experimental data is also presented. (SW)

7070 PHENOMENOLOGICAL DESCRIPTION OF NUCLEAR ROTATIONAL SPECTRA BY THE USE OF ROTATIONAL FUNCTIONS IN TERMS OF ANGULAR MOMENTUM. Gupta, R. K.; Wahlborn, S.; Hjertman, L. (Forskningsinstitutet foer Atomfysik, Stockholm). Phys. Scr.; 6: No. 5-6, 261-265(1972).

The use of rational fractions in terms of a suitably defined angular momentum variable is further examined for describing the rotational spectra below the Yrast region ($I \leq 30$). As a specific example, a four-parameter expression for the moment of inertia is applied and found to fit well the spectra of many good and several soft rotors with spins $I \leq 22$. The systematics of the parameters are also studied. The work is limited to ground-state rotational bands of even–even nuclei. (SW)

7071 NUCLEAR GIANT RESONANCES, SUM RULES, EFFECTIVE CHARGES, AND SUCH-LIKE. Satchler, G. R. (Oak Ridge National Lab., TN). Comments Nucl. Particle Phys.; 5: No. 5, 145-151(1972).

A discussion is presented on the experimental discovery of new giant resonances at high (~10 MeV and above) excitation energies in nuclei. By "giant resonances" is meant highly collective modes of excitation in which an appreciable fraction of the nucleons of a nucleus move together, and it may be appropriate to think of these modes in hydrodynamic terms like the oscillations in shape of a liquid drop. The giant dipole ($L = 1$, $T = 1$, $S = 0$) has been known for quite some time from photon scattering and absorption; recently it has been excited by inelastic electron scattering. Inelastic scattering of electrons and hadrons from nuclei has indicated the existence in all the nuclei so far studied of a giant collective state, most probably isoscalar and quadrupole, just below the giant dipole resonance. In addition there is some evidence for other giant resonances, particularly the "spin-wave" 1^+ type. (UK)

7072 HEAVY-ION TRANSFER REACTIONS AND NUCLEAR SPECTROSCOPY. Robson, D. (Florida State Univ., Tallahassee). Comments Nucl. Particle Phys.; 5: No. 5, 129-133(1972).

Reference is made to the advent of better and more systematic experiments involving transfer reactions induced by heavy ions. From this work it is becoming clearer that heavy ion reactions can be used as an aid to nuclear spectroscopy and to provide selective information that is not easily available by alternative methods. A few recent examples are considered under the following headings: γ-dependence of heavy ion induced reactions; selective excitation of "stretched" configurations; and state dependence of two-neutron transfer reactions. (UK)

7073 GROSS FEATURE OF HEAVY-ION REACTIONS: TRANSFERRED ANGULAR MOMENTUM AND Q-VALUE DEPENDENCES. Nagatani, K. (Brookhaven National Lab., Upton, NY); Ichimura, M.; Arima, A. Phys. Scr.; 6: No. 5-6, 289-295 (1972).

Cluster transfer reactions induced by heavy ions were investigated using distorted-wave Born approximations. In particular, gross features of Q-value and transferred angular momentum L_{tr} dependences in cross sections were studied. It was found that cross sections are sensitive to both these two factors, i.e., L_{tr} and Q. Calculations were performed in a wide range of the L_{tr}–Q plane. The trajectory of cross section maxima in the L_{tr}–Q plane thus obtained was also explained by a simple schematic model. A selectivity of populating high-spin states can be seen in this L_{tr}–Q plane plot. Some experimental data may be understood by such considerations. (SW)

7074 INTRINSIC-EXCITATION-COUPLED-TO-ROTATOR MODEL (IECRM) FOR ODD-MASS NUCLEI. Mikhailov, I. N.; Karadzhov, D.; Shaker, M. O. (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Scr.; 6: No. 5-6, 285-288(1972).

In the present work a new approach to the low-lying (rotational) spectra of the odd-mass deformed nuclei is presented. Starting from the many-body Schroedinger equation one reaches the equations of a model, called "intrinsic-excitation-coupled-to-rotator" (IECRM). To do this we use the knowledge concerning ground-state rotational bands and energies in neighboring even–even nuclei and apply a projection technique. It is shown that IECRM is a generalization of the well-known "rotator model" and gives, at the same time, a more adequate procedure when one works (as usually) in a limited basis of single-(quasi)-particle states. As a consequence it follows that the core parameters of an odd-mass nucleus are considerably changed in comparison with the corresponding quantities of the even–even neighboring nuclei. (SW)

7075 PHONON CRANKING MODEL. Fogel, T.; Haapakoski, P.; Lipas, P. O. (Univ. of Helsinki). Phys. Scr.; 6: No. 5-6, 259-260(1972).

The cranking model is applied to an intrinsic Hamiltonian for harmonic quadrupole vibrations of an axially deformed nucleus. The ground state is solved exactly in terms of quadrupole phonons, and a fairly simple two-parameter description is obtained for the rotational energies. The VMI model is contained as an approximation in the present formulation; its "negative moment of inertia" is explained accordingly. The departure from axial shape with increasing rotation is discussed. (SW)

7076 MANY-PARTICLE SYSTEMS. 8. Saturation and a Lower-Bound Shell Model. Horton, G. M. (London Univ.). J. Phys., A (London); 6: No. 5, 610-614(May 1973).

The lower-bound shell model developed by Carr and Post (Carr, R. J. M. and Post, H. R., J. Phys. A: Gen. Phys. 1, 1968, 596-609) is applied to a certain class of non-local two-body interactions and shows saturation. The case of the Yamaguchi interaction is worked out in detail. (auth)

7077 CONNECTION OF THE K-HARMONIC METHOD WITH THE METHOD OF GENERATOR COORDINATES. Obukhovskii, I. T.; Smirnov, Yu. F.; Tolstoi, V. N.; Shitikova, K. V.; El'Batanuni, F. (Moscow State Univ.). Yadern. Fiz.; 17: No. 4, 742-749 (Apr 1973). (In Russian).

The connection between the K-harmonic method with the method of generator coordinates is discussed. For the case of the bound states of nuclei the system of the Hill–Wheeler integral equations is written which is equivalent to the system of differential equations of the K-harmonic method. The method of approximate solutions of these integral equations is considered which is reduced to diagonalization of Hamiltonian in nonorthogonal basis composed of the shell model wave functions with different oscillator parameters. The optimal values of these parameters are obtained by minimization of the energy. The calculation is made for ^{3}H nucleus with nucleon-nucleon interactions as a square well shows a reasonable convergence of expansion in nonorthogonal basis. The advantage of the method is that all the calculations are made using conventional formulas of the shell model without explicit use of multidimensional spherical coordinates. (auth)

7078 DISTORTION EFFECTS IN EQUIVALENT LOCAL POTENTIALS. Coz, M.; Munro, J. K. Jr. (Univ. of Kentucky, Lexington). Yadern. Fiz.; 17: No. 4, 706-722(Apr 1973). (In Russian).

The possible distortion effects in the method of equivalent local potential (ELP) due to contribution of small distances are discussed. When ELP method is applied to a Hartree–Fock (HF) nonlocal potential obtained from a harmonic oscillator basis, strong distortion effects appear near the origin. These effects originate in an attempt to represent an irregular solution using a complete set of orthonormal functions which satisfy the same boundary conditions as the regular solution. A direct consequence of this procedure is the appearance of strong repulsive effects in the ELP's obtained from the HF potentials, in particular, for the $l = 0$ (S-wave case). It is shown how to avoid these distortions separating the local contribution from the nonlocal prior to application of the ELP method. Some other short range effects are discussed. (auth)

7079 STRUTINSKY'S AVERAGING METHOD. Brack, M.; Pauli, H. C. (Univ., Basel). Nucl. Phys.; A207: No. 2, 401-424(1973).

The averaging procedure in Strutinsky's method of shell corrections is formulated for a general type of averaging function. In the case of the harmonic-oscillator potential, the method is proved analytically to give the same results as semiclassical methods. For the infinite-rectangular-box potential, an uncertainty in the value of the shell correction δU of up to ≈ 0.5 MeV is shown to exist, the semiclassical value lying within these limits. In using realistic finite-depth potentials, no restrictions need to be made on the validity of Strutinsky's method, and the uncertainty in the values of δU is estimated to be less than ≈ 0.5 MeV. (auth)

7080 NEUTRON STAR MATTER AT SUB-NUCLEAR DENSITIES. Negele, J. W.; Vautherin, D. (Massachusetts Inst. of Tech., Cambridge). Nucl. Phys.; A207: No. 2, 298-320(1973).

An extremely simple form for the energy density of a nuclear many-body system derived from the two-body nucleon-nucleon interaction is used to determine the ground state configuration of matter at sub-nuclear density. As the baryon density is increased, nuclei become progessively more neutron rich until neutrons eventually escape, yielding a Coulomb lattice of bound neutron and proton clusters surrounded by a dilute neutron gas. The clusters enlarge and the lattice constant decreases with increasing density, approaching a completely uniform state near nuclear density. (auth)

7081 TWO MECHANISMS OF ELASTIC SCATTERING IN THE OPTICAL NUCLEAR MODEL. Morozov, V. M.; Zubov, Yu. G.; Lebedeva, N. S. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 17: No. 4, 734-741(Apr 1973). (In Russian).

The experimental data are obtained contradicting the concept of the optical model on the existence of two noncoherent processes of neutron elastic scattering: the shape-elastic scattering and the compound-elastic scattering. The absence of compound-elastic scattering in one-channel case with the ^{208}Pb nucleus shows that in general case the "absorption" in the optical model has no physical meaning. (auth)

7082 NUCLEAR REACTIONS AND REACTION MECHANISMS. II. Naida, J. C. (Facultad de Ciencias, Valladolid, Spain). Energ. Nucl. (Madrid); 16: No. 80, 613-621(1972). (In Spanish).

Direct interaction processes are studied and a complete description of their characteristics is given. The theory of these reactions is explained from the viewpoint of the distorted-wave Born approximation (DWBA) and the dispersion theory of direct interactions (TDID). A rigorous mathematical formulation is given of each, and the most appropriate field of application is established for each of the theories. (tr-auth)

7083 RECOMMENDED VALUES OF (n,2n) CROSS-SECTIONS AT 14.7 MeV. Boedy, Z. T.; Csikai, J. (Kossuth Univ., Debrecen, Hungary). At. Energy Rev.; 11: No. 1, 153-165(Apr 1973).

A survey is given on the present knowledge of (n,2n) cross sections at 14.7 MeV. Recommended values are tabulated for elements and isotopes. These have been obtained on the basis of experimental data supplemented by N-Z systematics and are compared with values resulting from empirical formulas. (auth)

7084 K-ELECTRON CAPTURE TO POSITRON EMISSION RATIOS IN ALLOWED TRANSITIONS. A Critical Analysis. Fitzpatrick, M. L.; Ledingham, K. W. D.; Gourlay, J. Y.; Lynch, J. G. (Univ. of Glasgow). J. Phys., A (London); 6: No. 5, 713-721(May 1973).

All available experimental K/β^+ and ϵ/β^+ ratios for allowed transitions are reviewed. A critical comparison is made between experimental and theoretical K/β^+ ratios. The following questions are asked: (i) can these experiments be used to derive the magnitude of a possible induced tensor interaction? (ii) is there a departure from theory, particularly in the high-Z region? It is pointed out that more experimental work is necessary, especially for values of $Z > 30$. (auth)

7085 DENSITY OF EXCITED PARTICLE-HOLE STATES IN THE MODEL OF SUPERFLUID NUCLEUS. Ignatyuk, A. V.; Sokolov, Yu. V. Yadern. Fiz.; 17: No. 4, 723-733(Apr 1973). (In Russian).

The effect of the correlation-type residual interactions on the density of states of a system with the fixed number of excited quasiparticles is considered. The thermodynamical functions of such system are calculated in continuous spectrum approximation. (auth)

7086 CHARACTERISTICS OF STRONGLY HINDERED, ALLOWED β TRANSITIONS AND HIGHER-ORDER EFFECTS. Subotovich, M.; Bazylyuk, D.; Budzynski, M.; Ptashek, I.; Sarzhinski, Ya. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 53-62(Jan 1973). (In Russian).

Simple theoretical expressions were sought for all characteristics of allowed delayed β transitions, the peculiarities of which had been discovered by experiment, similar to the form-factor formulas $C = C(W)$ and the formulas for $\beta-\gamma$ angular correlations, $A_2(W)$, reported by other workers. Pursuant to this work, derivations were obtained for the longitudinal polarization of electrons, circular polarization for $\beta-\gamma$ angular correlations, the angular distribution of β particles emitted by polarized nuclei, and electron–neutrino angular correlations. Reference is made to experimental data from the literature in support of the formulas advanced. (KSW)

7087 COMPARISON OF THE THEORETICAL AND EXPERIMENTAL VALUES FOR K/β^+ BRANCHING IN SMALL-Z REGION. Suslov, Yu. P. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 77-81(Jan 1973). (In Russian).

Overlap and exchange effects were studied for Z from 6 to 15, with hole excitation of the atomic shell after K-capture taken into account. A comparison was made of experimental and theoretical values of K/β^+ in the small-Z region. (1 figure, 1 table) (tr-auth)

7088 ROTATIONAL SINGLE-PARTICLE STATES OF NON-AXIAL ODD–ODD NUCLEI. Begzhanov, R. B.; Giyazov, I.; Sharipov, Sh. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 127-131(Jan 1973). (In Russian).

The energy spectrum of the excited states of nonaxial odd–odd atomic nuclei with $j_p = 5/2$, $j_n = 3/2$ was calculated. The β and γ oscillations were not taken into account. A comparison of calculated and experimental energy levels was made for the nuclei ^{60}Cu, ^{62}Cu, ^{64}Cu, and ^{66}Cu. (2 figures, 1 table) (tr-auth)

7089 POLAR APPROXIMATION FOR THE $(\alpha,2\alpha)$ REACTION AT 25 TO 100 MeV ENERGY. Avakov, G. V.; Dolinskii, E. I.; Turovtsev, V. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 171-176(Jan 1973). (In Russian).

A systematic investigation was conducted of the role of the polar mechanism of quasi-elastic scattering in the reaction $(\alpha,2\alpha)$ on the basis of all experimental data for 1p-shell nuclei. By way of example, the differential cross section for $^9Be(\alpha,2\alpha)^5He$ and the α-particle energy spectrum of $^6Li(\alpha,2\alpha)D$ were examined in detail. It was concluded that the polar model qualitatively describes the forms of the functions of angular correlations and energy spectra. (3 figures) (KSW)

7090 MECHANISM OF THE (n,2n) REACTION AT 10 TO 20 MeV ENERGY. Ol'khovskii, V. S.; Ezhov, S. N. (Kiev State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 161-170(Jan 1973). (In Russian).

The use of Faddeev's equations for describing direct processes in an (n,2n) reaction is analyzed in the approximation of an infinitely heavy nucleus. The possibility of using the method of distorted waves is discussed, with Pauli's principle for describing direct knock-out processes taken into account. The results of the numerical calculations are compared with experimental data and with results predicted from a statistical evaporation model. (5 figures) (tr-auth)

7091 INTRODUCTION OF SPIN AND ISOTOPIC SPIN VARIABLES INTO THE INTEGRAL EQUATIONS OF THE NONRELATIVISTIC FOUR-BODY PROBLEM IN AN S-APPROXIMATION FOR THE TWO PARTICLE INTERACTION. Komarov, V. V.; Popova, A. M.; Serebryakov, S. G. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 194-200(Jan 1973). (In Russian).

A theoretical treatment is offered in which there is introduced into the equations for four particles the spin and isotopic-spin variables in an S-approximation for the two-particle interaction. Application of the principle was made to the reactions $d + d$, $T + N$, and $^3He + N$. (KSW)

7092 CONFORMITY BETWEEN THE DIAGRAM TREATMENT AND THE SHELL MODEL IN DESCRIBING PHOTONUCLEAR REACTIONS. Dubovoi, E. I. (Radiotechnical Inst., Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 189-193(Jan 1973). (In Russian).

The agreement between the matrix elements of the radiative transition $A + \gamma \rightarrow A^*$ and the photonuclear reaction $A(\gamma,N)A - 1$ was examined, on the one hand, within the formalism of the single-particle shell model and allowing for channel coupling, and on the other hand, within the diagrammatic approach. The matrix element of the shell model agreed with the matrix element which corresponded to the separate triangular and polar nonrelativistic diagrams. (3 figures) (tr-auth)

7093 MICROSCOPIC DESCRIPTION OF THE WIDTH OF HIGHLY EXCITED ANALOG STATES. Akbari, M. Yu.; Govyadinova, L. A.; Zhivopistsev, F. A.; Lukashev, A. V.; Shitikova, K. V.; Erokhin, K. M. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 201-206(Jan 1973). (In Russian).

The widths of highly excited analog states are considered. The coupling with configurations of a highly complex nature responsible for nuclear forces is analyzed. Dispersion widths $\Gamma\downarrow$ were evaluated for states of a highly complex nature, and the decay widths of analog levels in continuous spectra $\Gamma\uparrow$ were examined. Numerical calculations were conducted for the nuclei ^{60}Ni and ^{90}Zr. (3 figures) (tr-auth)

7094 STRUTINSKY SMOOTHING AND THE PARTITION FUNCTION APPROACH. Jennings, B. K. (McMaster Univ., Hamilton, Ont.). Nucl. Phys. A107: No. 3, 538-544(1973).

The Strutinsky shell correction is analytically shown to be equivalent to the shell correction obtained from the partition function approach, provided certain restrictions on the Strutinsky smoothing parameter are met. (1 figure) (auth)

7095 FOUR APPROACHES TO THE FUNCTION OF INERTIA IN A SOLVABLE MODEL. Holzwarth, G. (Massachusetts Inst. of Tech., Cambridge). Contract AT(11-1)-3069. Nucl. Phys. A207: No. 3, 545-564(1973).

Four different methods of calculating the mass function for large-amplitude collective motion are applied to the Lipkin model: adiabatic time-dependent Hartree–Fock (ATDHF), infinitesimal generators (IG), constrained RPA, and the generator-coordinate method (GC). ATDHF and GC give identical results. IG and RPA lead to the same result only in the limit of vanishing constraint. The corresponding collective Hamiltonian gives good results for the low-lying excitation energies, while the cranking approximation seems to be rather poor for this case. (4 figures) (auth)

7096 PARTIAL STATE DENSITIES FROM REALISTIC SINGLE-PARTICLE STATES. Williams, F. C. Jr.; Mignerey, A.; Blann, M. (Univ. of Rochester, NY). Nucl. Phys.; A207: No. 3, 619-625(1973).

Results are presented for a general method of computing partial state densities (those for a specified number of excited particles and holes) for one-fermion systems with realistic sets of single-particle levels. The results presented are for nuclides near the 50-proton shell closure; Nilsson single-particle orbitals were used. The effects of shell structure and of nuclear deformation on partial state densities are illustrated. Results are compared with the results of the equidistant-spacing model, and experiments are suggested to establish whether or not the predicted effects are to be found experimentally. (3 figures) (auth)

7097 EXPLICIT EXPRESSIONS OF THE ORBITAL FRACTIONAL PARENTAGE COEFFICIENTS FOR THE GROUND AND FIRST-EXCITED U(3(n−1)) STATES OF NUCLEI WITH $n \leq 16$. Yankauskas, K. I.; Sabalyauskas, L. Yu.; Petrauskas, A. K. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 12: No. 4, 543-578(1972). (In Russian).

The explicit formulas for the two-particle fractional parentage coefficients for the calculation of matrix elements of central or noncentral two-particle operators for the ground U(3(n−1)) nuclei states are obtained. Certain types of one-particle orbital fractional parentage coefficients for the first excited U(3(n−1)) nuclei states are also presented. Numerical tables of the one-particle fractional parentage coefficients for the first-excited U(3(n−1)) states for nuclei with $n = 11, 12$ are given. (auth)

7098 MODEL CALCULATION IN A NEW APPROACH TO THE THREE-BODY PROBLEM. Gloeckle, W.; Ueta, K. (Univ., Heidelberg). Z. Phys.; 258: No. 1, 64-80(1973).

A method to calculate the binding energy of a system of three identical particles is proposed. The kernel of a previously derived integral equation in two variables is replaced by an approximation of finite rank. It turns out that a one term approximation is already sufficient to determine the binding energy very well. (GE)

PHYSICS (PLASMA AND THERMONUCLEAR)

7099 PLASMA PHYSICS INDEX. Volume 8, No. 3, 1973. Bibliography, Author Index, Subject Index. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 176p.

This listing contains 520 references. (MOW)

Confinement and Heating

7100 (COO–2180-1) STUDIES OF CHARGED-PARTICLE DISTRIBUTIONS IN AN ELECTROSTATIC CONFINEMENT SYSTEM. Progress Report, November 1, 1971–July 31, 1972. Gardner, A. L. (Brigham Young Univ., Provo, Utah (USA). Dept. of Physics and Astronomy). 1972. Contract AT(11-1)-2180. 18p. Dep. NTIS $3.00.

A spherical inertial–electrostatic ion-confinement device employing six ion guns was placed in operation and frequency shifts of the $TM_{4,1,0}$ and $TE_{1,8,N}$ modes were observed (in the vicinity of 11 GHz) as the high voltage is removed from the inner electrode. It is felt that the limited "single-shot" operation to date confirms the utility of the basic method of applying resonant-cavity techniques to study the particle distributions. Further effort is being directed toward modulating the high voltage and providing synchronous detection that will permit continuous recordings of the frequency shifts of two (or more) resonances to be made as the operating parameters are slowly changed. (auth)

7101 (EUR-CEA-FC-669) ABSORPTION OF MAGNETOACOUSTIC WAVES BY ION-ION COLLISIONS IN A DOUBLE ION PLASMA. Alvarez de Toledo, F. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Nov 1972. 196p. (In French). Dep. NTIS (U. S. Sales Only) $12.00.

Thesis. Submitted to Paris Univ., Orsay (France).

The absorption by ion–ion collision of fast hydromagnetic waves propagating in an axially symmetric inhomogeneous plasma composed of 50% hydrogen and 50% deuterium was studied in the central conductor Stator-B toroidal device. It was demonstrated that, in accordance with theory, an eigenmode of the plasma column may be excited when favorable collisional absorption conditions prevail between the two types of ion. The attenuation of the wave outside the excitation coil and the power absorbed by the plasma were measured. The agreement between the predictions of the theoretical model and the values measured confirm the existence of the phenomenon. This direct heating mechanism can be used to rapidly raise the ion temperature of the initial containment phase of closed configurations for medium and high densities. (FR)

7102 (UCID–16264) CHARGE EXCHANGE AT THE SURFACE OF MIRROR-CONFINED PLASMAS. Fowler, T. K. (California Univ., Livermore. Lawrence Livermore Lab.). 10 May 1973. Contract W-7405-eng-48. 16p. Dep. NTIS $3.00.

The conditions required to overcome charge exchange in mirror machines, both for transient experiments with active walls and for steady-state conditions appropriate to reactors are calculated. The result is in the form of the required wall-pumping capability in the first instance, and for steady state, the necessary energy such that ionization adequately dominates over charge exchange. The condition to overcome charge exchange in a mirror machine sustained by neutral injection turns out to be the condition that the total neutral flux impinging on the plasma surface be less than the rate of trapping ions in a shell of thickness l at the surface. To evaluate this condition requires in addition the calculation of the neutral flux as a function of beam current. The mixing length l is discussed. (MOW)

7103 STOCHASTIC HEATING OF A PLASMA DUE TO DEVELOPMENT OF LANGMUIR TURBULENCE INSTABILITY. Khakimov, F. Kh.; Tsytovich, V. N. (Tadzhik State Univ., Stalinabad, USSR). Zh. Eksp. Teor. Fiz.; 64: No. 4, 1261-1271(Apr 1973). (In Russian).

A nonlinear theory of absorption of Langmuir oscillations under conditions of a developed Langmuir turbulence is developed. The spectra of strong turbulence of low-frequency pulsations induced by Langmuir turbulence are determined. Electron heating due to low-frequency oscillations generated by Langmuir turbulence is estimated. The calculations are carried out on the assumption of one-dimensional electron motion (magnetization), i.e. $\omega_{He} \gg \omega_{pe}$. (auth)

7104 HEATING OF MAGNETIZED PLASMA UNDER CONDITIONS OF PARAMETRIC INSTABILITY. Demirkhanov, R. A.; Khorasanov, G. L. High Temp. (USSR) (Engl. Transl.); 10: No. 5, 1027-1028(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 5, 1139-1141 (1972).

The results are presented of an investigation of the heating of a magnetized plasma under conditions of parametric resonance at high plasma densities. The parameters of the investigated plasma were as follows: radius of plasma filament 3 cm, length of filament 100 cm, $n = (4 \text{ to } 7) \times 10^{10}$ cm^{-3}, initial plasma temperature $T_e \sim T_i \sim 0.3$ eV. The plasma filament was in a longitudinal homogeneous magnetic field of intensity $H_0 = 3.5$ (kOe). The plasma was produced by thermal ionization of the cesium by a niobium ionizer heated to $T \sim 2500$°K. At a distance L from the ionizer there was placed a cold plate limiting the length of the filament. The high-frequency voltage was applied directly to the end electrodes from a GSS-7 generator. The frequency of the alternating electric field ranged from 20 to 200 MHz. The electron temperature and the plasma density were measured with double Langmuir probes located at the center of the chamber on its axis. All the measurements were carried out in the continuous regime. (MOW)

Diagnostics

Refer also to abstract 7131.

7105 (AD-754021) HIGH-TEMPERATURE PLASMA DIAGNOSTICS AND PROPERTIES. Final Report, July 1965—June 1972. Schrieber, P. W.; Hunter, Allen M. II (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Aug 1972. 23p. (ARL-72-102). NTIS.

The report is a close out synopsis of Work Unit LV-14, Project 7062 of the Thermomechanics Research Laboratory, Aerospace Research Laboratories. The synopsis covers the period from July 1965 to June 1972. Details of the work accomplished during this period may be found in the literature cited in the bibliography of the synopsis. (auth)

7106 (EUR-CEA-FC-679) DETERMINATION OF THE DENSITY, AND ENERGY SPECTRUM OF THE IONS OF A PLEIADE PLASMA USING AN OPTICAL DOPPLER SHIFT METHOD. Geller, R.; Hess, W.; Hesse, M.; Jacquot, B.; Jacquot, C.; Moulin, B.; Stevenin, P. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jan 1973. 31p. (In French). Dep. NTIS (U. S. Sales Only) $3.75.

In order to study the performance of an ion source, the density and energy of a proton beam were evaluated by an optical Doppler shift method utilizing the $H^+ + N_2 \rightarrow H_0(n = 4) + N_2^+$ and the $H_0(n = 4) \rightarrow H_0(n = 2) + H\beta$ atomic collision reactions. The $H\beta$ shift provides information about the proton energy spectrum; and photometric calibration of this line using a counting device enables the density of the accelerated protons to be measured. (FR)

7107 DEVELOPMENT OF UHF STANDARD OF HIGH PLASMA TEMPERATURES. Kandyba, V. V.; Ioselson, G. L.; Lander, V. A. (Kharkov State Inst. of Metrology). Metrologia; 9: No. 1, 1-7(1973).

Metrological aspects of the IPTS reproduction in the uhf range for the high and superhigh temperature region as well as the verification scheme are discussed. The latter is designed for graduating radiopyrometers and their antenna systems. A high temperature radiator which can form the basis for a high temperature uhf noise standard with a wide aperture is described. The source random error of the IPTS reproduction $\delta_{rand} = 0.21$ dB and the unaccountable part of the systematic error $\delta_{syst} = 0.21$ dB. The certification random error with this scheme is $\delta_{cert} = 6\%$. Methods are discussed for graduating radiopyrometers and their antenna systems against the radiator developed with the error of 6 to 10%. (auth)

7108 APPLICATION OF LASER SELECTIVE EXCITATION SPECTROSCOPY TO THE DIAGNOSTICS OF A POTASSIUM PLASMA. Rodrigo, A. B. Toronto; Univ. of Toronto (1972). National Library of Canada, Ottawa.

Thesis (Ph. D.).

A thermally tuned Q-switched ruby laser of moderate power, with emission wavelength at 6939 Å, was used to selectively excite the $4^2P_{1/2}-6^2S_{1/2}$ transition in the atoms of a pure potassium plasma of low degree of ionization produced in a hot cathode diode. A pulse of intensified spontaneous emission was observed at 6939 Å, 6911 Å, and at a number of other wavelengths, as a result of the laser selective excitation. The characteristics of the plasma intensified emission pulse were observed to depend on the local conditions of the plasma, at the point of intersection of the laser beam and the solid angle of observation, estimated by a Langmuir probe. In particular, it was observed that the signal decay time decreases as the free electron density increases. The possibility of using this type of interaction for the purpose of diagnosing the plasma was studied experimentally. The results obtained indicate that using an adequately tailored laser pulse it should be possible to measure the electron density and the excitation temperature in a potassium plasma in the range 10^{12} to 10^{14} cm^{-3} and 2000 to 3500°K, respectively. The spatial resolution associated with the measurement should be of the order of a few cubic millimeters, with a temporal resolution of better than 10^{-7} sec. Furthermore, because of the low power required for excitation, the plasma perturbation effects associated with the measuring technique are likely to be negligible. (Diss. Abstr. Int., B)

7109 HIGH-SPEED STEREOSCOPIC INVESTIGATION OF THE MOTION TRAJECTORIES OF LUMINOUS OBJECTS. Narusbek, E. A. (Inst. of Physical Problems, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1530-1532(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 204-206(1972).

A method is described for the simultaneous measurement of two projections of the cross section of a luminous object and the trajectories of its motion in space by means of two LI-602 slit dissectors. (auth)

7110 USE OF DIAMAGNETIC PROPERTIES OF A PLASMA TO DETERMINE ITS PARAMETERS IN PRESENCE OF AN EXTERNAL MAGNETIC FIELD. Lobov, G. D.; Shtykov, V. V. (Moscow Power Engineering Inst.). High Temp. (USSR) (Engl. Transl.); 10: No. 5, 990-991(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 5, 1106-1108 (1972).

The experimental use of external electromagnetic radiation to produce magnetic moments in the plasma is described. The dependence of the resultant magnetization vector on the frequency of the electromagnetic field is determined by the plasma parameters. The diagnostic use of this method is briefly described. (MOW)

7111 SPECTRAL DIAGNOSTICS OF THE PLASMA PLUME PRODUCED IN INTENSE METAL EVAPORATION UNDER LASER RADIATION. Batanov, V. A.; Bogatyrev, V. A.; Sukhodrev, N. K.; Fedorov, V. B. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 3, 825-832(Mar 1973). (In Russian).

Results are presented of a spectral diagnostics of the low-temperature plasma of a plume produced by intense millisecond optical radiation incident on metallic targets. Distribution of the temperature along the plume is measured in a broad range of intensities $I \sim (0.3 \text{ to } 3) \times 10^7$ W/cm² and atmospheric pressure $p = (0.1 \text{ to } 5)$ atm. Estimates of the electron density N_e are obtained. At a distance from the metal surface corresponding to a shock wave at rest with respect to the target, temperature maxima with values $T \approx (1.5 \text{ to } 2)$ eV are observed. The vapor temperature at a distance of the order of the size of the irradiated spot is several times greater than the critical temperatures of the metals investigated. This is direct proof that laser radiation of an intensity $I \sim 10^7$ W/cm² heats the dense vapor near the target. (auth)

Kinetics (General)

7112 (AD-737842) TIME-RESOLVED SPECTRAL OPACITY PROFILES AND ABSORPTION COEFFICIENTS IN NANOSECOND SPARK CHANNELS. Gemmer, W.; Gerke, H.; Fischer, H. (Technische Hochschule, Darmstadt (West Germany)). Mar 1971. Contract F61052-68-C-0039. 28p. (AFCRL-71-490). NTIS.

Time-resolved spectral opacities were observed in high-density nanosecond spark channels by application of a method developed by Meiners. The spark channel was backimaged into its origin by means of a surface mirror that reflected in separated parallel stripes only. Thus, the reflected light penetrated the channel in zones parallel to its axis. In case of a cylindrical symmetry, the absorption coefficient profile from the axis to its periphery can be calculated from the ratio of the spectral emissivity with and without reflection. In addition, the relative emission coefficient, the relative temperature, and the optical density profile can be determined. (auth)

7113 (AD-751255) SYNTHESIS OF A STABLE MAGNETOPLASMA. Technical Report, 1967–1969. Wingerson, R. C. (Aerospace Research Labs., Wright-Patterson AFB, OHIO). Oct. 1972. 34p. (ARL-72-125). NTIS.

A maximum entropy principle is used to determine the equilibrium distribution of a one-component, azimuthally symmetric magnetoplasma. From this distribution, the radial dependence of density, electric field, and magnetic field is determined for an ideal stable plasma. Further insight is gained by examining the theory of collisionless single particle motion. The implications of the ideal analysis are illustrated by numerical examples for both a deuterium and an argon plasma. Some major deficiencies of the ideal analysis are then presented and the effect of one of these, collisions between species, is examined to determine the collision integral for the Boltzmann equation which further constrains the plasma parameters. Finally, the relative relaxation times for various processes are determined. (auth)

7114 (AD-751256) LOW-FREQUENCY ELECTRON-TEMPERATURE FLUCTUATIONS IN FULLY IONIZED PLASMAS. Friz, W.; Mueller, G. L. J.; Palmer, R. S. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Oct 1972. 17p. (ARL-72-127). NTIS.

Experimental investigations were made to substantiate the existence of periodic fluctuations of the electron temperature accompanying drift-type instabilities in a Q device. Preliminary results of measurements are reported. For all cases measured, the normalized plasma temperature fluctuations T/T_0 were found to be smaller than the normalized density and floating potential fluctuations n/n_0 and $e\phi_f/kT_0$. The experimental results are compared to existing theory. (auth)

7115 (AD-753087) PLASMA PROPAGATION INTO LOW-PRESSURE GAS AND PLASMA IN A MAGNETIC FIELD. Final Scientific Report, 1 February 1969–30 June 1971. Kaufman, A. S. (Hebrew Univ., Jerusalem (Israel). Dept. of Physics). 31 Jul 1972. Contract F61052-69-C-0023. 15p. (AFCRL-72-673). NTIS.

The report summarizes investigations of plasma phenomena related to the propagation of plasma into an ambient gas. The phenomena are: the solar wind, electrostatic containment of an ionized gas, containment in crossed electric and magnetic fields and the positive column in a magnetic field. (auth)

7116 (AD-754018) PLASMA INTERACTIONS WITH GAS FLOW AND MAGNETIC FIELDS. Final Report, July 1965–April 1972. Kramer, K. R.; Schrade, H. O. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Aug 1972. 19p. (ARL-72-103). NTIS.

A brief description and results of the various research efforts conducted during the period of mid 1965 to April 1972 under an in-house theoretical and experimental research program that was supported by a small experimental effort conducted by students from the Air Force Institute of Technology. Also, research contracts with university and industrial scientists supported related efforts. The appendix contains a list of the publications and presentations accomplished under the in-house portion of the program. (auth)

7117 (AD-754020) HIGH-PRESSURE PLASMA RESEARCH. Final Report, July 1965—April 1972. Bauder, U. H. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Aug 1972. 17p. (ARL-72-104). NTIS.

The research goals, the approach, and the results of the High Pressure Plasma Research, Group V-4, are presented. Also included is a brief description of Air Force applications of this research as well as comprehensive list of publications and presentations as they were generated by in-house and contractual efforts. (auth)

7118 (AD-754022) STABLE CONFIGURATION OF ELECTRIC ARCS IN TRANSVERSE MAGNETIC FIELDS. Schrade, H. O. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Aug 1972. 30p. (ARL-72-109). NTIS.

Deviations from rotational symmetry of arc columns exposed to transverse magnetic fields cause convection and a momentum transport between the column and its surrounding gas. As a consequence, the arc moves and changes its geometry until it reaches a stable configuration. Based on the momentum transport equation, the arc behavior is discussed under various operating conditions, and stable arc configurations are determined. In particular, the stability criteria of a balanced arc column in a transverse gas flow and magnetic field are derived. (auth)

7119 (AD-755387) SYNCHROTRON-CHERENKOV RADIATION OF RELATIVISTIC ELECTRONS IN A COLD PLASMA. Kalman, G.; Yukon, S. (Boston Coll., Chestnut Hill, Mass. Dept. of Physics). Apr 1972. Contract F19628-71-C-0078. 107p. (AFCRL-72-290). NTIS.

The radiation emitted by a relativistic electron in a cold magnetoplasma is calculated employing the method of energy loss. While the power loss per unit frequency interval in the neighborhood of the ionic, electronic, or plasma resonance is divergent, it is shown to be integrable for each harmonic of the relativistic gyrofrequency. The sum of the power losses over all harmonics, though, is divergent as the logarithm of the maximum harmonic number, for a wide frequency domain depending on the pitch angle alpha and direction of propagation theta. By decomposing the total radiation into longitudinal and transverse parts the transverse portion is shown to be finite everywhere. A computer code was developed to calculate the total and transverse power spectra for arbitrary plasma and particle parameters. Results for a variety of particle energies and pitch angles are presented. (auth)

7120 (TRITA-EPP-72-31) EXPERIMENTAL INVESTIGATION OF AN IONIZING WAVE IN A COAXIAL PLASMA GUN. Axnaes, I. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). Dec 1972. 55p. Dep. NTIS U. S. Sales Only) $4.75.

With a view to clarifying the phenomenon of anomalous interaction between plasma and neutral gas, the ionizing wave in a coaxial plasma gun with an azimuthal magnetic bias field is studied experimentally. The discharge current, filling pressure (H_2), and magnetic field are chosen so that the plasma is weakly ionized. A lower limit to the ionization frequency is obtained by measuring the relaxation time of a burning-voltage transient caused by a sudden increase of the discharge current. The conditions before and after the transient are studied by means of floating double probes. The experimental results are compared with theoretical predictions from electron-heating mechanisms, which are classical in the sense of involving only binary collision processes and not collective interactions. It is found that the experimentally measured ionization frequency is larger by 10 to 100 times than that theoretically predicted for classical processes. (auth)

7121 ELECTRICAL CONDUCTIVITY FROM ELECTRIC ARC MEASUREMENTS. Devoto, R. S.; Mukherjee, D. (Stanford Univ., CA). J. Plasma Phys.; 9: No. 1, 65-76(Feb 1973).

A technique involving the use of a trial function containing several adjustable parameters has been developed for the purpose of deducing the electrical conductivity from measurements on the electric arc. It is used to re-analyze experiments in argon, xenon, and nitrogen. Some improvement in agreement between theory and experiment is noted. (auth)

7122 COMMENTS ON THE RECONNECTION RATE OF MAGNETIC FIELDS. Parker, E. N. (Univ. of Chicago). J. Plasma Phys.; 9: No. 1, 49-63(Feb 1973).

The behavior of magnetic fields in the neighborhood of an X-type neutral point is examined. The treatment is kinematical, specifying the velocity field v and constructing solutions to the hydromagnetic equation for B. The calculations demonstrate that the reconnection rate is controlled by the diffusion in the near neighborhood of the neutral point, and is not arbitrarily large, as has been suggested by similarity solutions of the complete field and fluid equations for vanishing diffusion. (auth)

7123 EXPERIMENTAL STUDY OF FORCE-FREE COLLINEAR PLASMA STRUCTURES. Nolting, E. E.; Jindra, P. E.; Wells, D. R. (Univ. of Miami, Coral Gables, FL). J. Plasma Phys.; 9: No. 1, 1-15(Feb 1973).

Detailed measurements of the trapped magnetic fields and currents in plasma structures generated by conical theta pinches are reported. Studies of these structures interacting with a magnetic barrier, and with each other in a collision at the center of a magnetic mirror, are described. The magnetic well formed by the collision was studied by simultaneous use of several diagnostic techniques. The measurements are in agreement with a force-free, collinear magnetic field configuration. (auth)

7124 DEVELOPMENT OF INSTABILITY AND THE NEUTRON EMISSION BY A Z-PINCH. Aleksandrov, V. V.; Kozal'skii, N. G.; Luk'yanov, S. Yu.; Rantsev-Kartinov, V. A.; Stepanenko, M. M. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 4, 1222-1227(Apr 1973). (In Russian).

High-current pulsed discharges in hydrogen and deuterium are studied with apparatus possessing high time and space resolution. It is shown that instabilities of the constriction type begin to develop at early stages of compression of the plasma column, long before the plasma concentration at the axis is maximal. These instabilities are characterized by a very pronounced spatial periodicity. The time dependence of neutron emission is investigated. A correlation between the beginning of the neutron pulse and phase of the discharge current is established. The results are compared with the theoretical predictions. (auth)

7125 STUDY OF FLUCTUATION AND COLLISIONAL PHENOMENA IN REAL AND SIMULATION PLASMAS. Klein, H. H. Jr. College Park, MD; Univ. of Maryland (1972). 179p. University Microfilms Order No. 73-11,398.

Thesis (Ph. D.).

The probability distribution of electric fields in plasmas is calculated for plasmas in various states of stability. A computer code which simulates plasmas was written, and probability distributions were determined numerically through the simulations. It was found that for plasmas in thermal equilibrium the analytic and numerical results were in good agreement, thus confirming results of existing theories for real plasmas in thermal equilibrium. However, for nonthermal plasmas, it was found through the simulations that the probability can be altered significantly from that determined from plasmas in thermal equilibrium. A new theory is based on the distribution of wave fields in the plasma. The results of this treatment and the results of the simulations agree favorably. A theoretical analysis was made of the collisional damping of plasma oscillations. The treatment is similar to Comisar's but modified to include the finite size particle effects to allow comparison with computer simulation "experiments." The results of this analysis are compared to the results of the damping obtained from such computer simulations. The analytic and numerical results agree favorably. (Diss. Abstr. Int., B)

7126 DC CONDUCTIVITY OF A PARTIALLY IONIZED CESIUM PLASMA IN A MAGNETIC FIELD. Murray, F. J. New York; New York Univ. (1972). 110p. University Microfilms Order No. 73-11,742.

Thesis (Ph. D.).

The dc electric conductivity tensor of a weakly ionized, homogeneous cesium plasma in near-thermodynamic equilibrium is investigated. The cesium plasma is contained between two coaxial tantalum cylinders separated by two dielectric end caps, which along with the cylinders, form the plasma chamber boundaries. The cylinders are radiatively heated to a temperature of 1200°K as measured by an optical pyrometer. The heating elements are coaxial tantalum cylinders welded together at one end. These cylinders are ohmically heated. A coaxial design was employed in order to reduce the magnetic fields from the heating current to a minimum. A surface ionization detector monitors the neutral cesium efflux through a small hole in the outer cylinder, and the plasma density is estimated from the Saha equation. A cesium oven whose temperature can be carefully controlled was used to independently vary the plasma density, and a set of Helmholtz coils produces a uniform magnetic field parallel to the cylinder axes. The transverse component of the conductivity tensor, σ_T, is obtained from the current—voltage characteristics of the plasma cylinders and geometrical factors. Voltage versus current curves were obtained for neutral densities from 10^{11} to 10^{15} particles/cm^3 and for magnetic fields from 0 to 180 gauss. The measured conductivities are compared to results obtained from transport theory for a weakly ionized plasma. The predicted dependences of σ_T on magnetic field and neutral number density were verified. The electron—cesium atom momentum transfer cross section is estimated from the data to be $(.90 \pm .32) \times 10^{-14}$ cm^2. (Diss. Abstr. Int., B)

7127 MEASUREMENTS OF THE ENERGY LOSS OF A CHARGED TEST-PARTICLE BEAM IN AN EQUILIBRIUM CESIUM PLASMA. Klavan, I. L. New York; New York Univ. (1972). 164p. University Microfilms Order No. 73-11,727.

Thesis (Ph. D.).

Measurements were made of the energy loss of a 35- to 150-eV tenuous cesium ion beam in passage through a thermal equilibrium cesium plasma. The plasma was produced in a device developed for this experiment, through injection of cesium vapor into a hot grounded cylindrical tantalum container. The plasma was heated by radiation from two larger, ohmically heated tungsten cylinders concentric with the plasma cylinder. Care was taken to minimize external magnetic and electric fields within the plasma region. The temperature of the plasma was determined by an optical pyrometer viewing through a small hole in the plasma cylinder. The neutral density within the cylinder was determined by monitoring, with a hot wire detector, the efflux of atoms from the pyrometer observation hole. The plasma density was then calculated using the Saha equation. Energy-loss measurements were made using plasma temperatures of 2100 and 2500°K, as a function of plasma density, which was varied from 10^{10} to 10^{12} cm^{-3}. The data are found to be in good agreement with the theoretical predictions of Itikawa and Aono. (Diss. Abstr. Int., B)

7128 TWO STATES OF AN AQUEOUS PLASMA IN AN H-PINCHED DISCHARGE. Gorshkova, L. D.; Gorshkov, V. A.; Podmoshenskii, I. V. High Temp. (USSR) (Engl. Transl.); 10: No. 5, 833-836(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 5, 921-925 (1972).

Experiments were performed in a pulse discharge which occurred in a flue and was pinched to its floor by a lattice-type magnetic field at a pressure of 9 atm, $I \simeq 7,000$ A; $\tau \simeq 8 \times 10^{-4}$ sec; $H = 15,000$ Oe. When the walls of the flue are covered with ice along the length of the channel, two zones at temperatures of 16,000 and 24,000°K are present, whereas the plasma is absent at intermediate temperatures. By electrical potential oscillography, high-speed photography, and spectral scanning, it is shown that the discharge is unstable in this region for $T \simeq 24{,}000°K$. The observed instability is related to the manner in which the discharge becomes superheated, but under conditions when radiant, thermal conductivity is present in a collisionally stable plasma. For a large discontinuity in the ionization potentials of O I, H I, and O II, two plasma temperatures occur for which the energy balance of the H-pinched discharge is fulfilled. (auth)

7129 BOLOMETRIC METHOD FOR DETERMINING HEAT FLUX FROM A PLASMA TO A DIELECTRIC IN PULSED EROSIONAL ACCELERATORS. Gubarev, V. Ya.; Kozlov, N. P.; Leskov, L. V.; Protasov, Yu. S. (Higher Technical School, Moscow). High Temp. (USSR) (Engl. Transl.); 10: No. 5, 1025-1026 (1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 5, 1138-1139 (1972).

The experiments were carried out in an experimental unit and a model of an accelerator. The dielectrics used were polytetrafluoroethylene [Teflon] and Plexiglas. The discharge was triggered along the surface of the dielectric by a low-power plasma injector of the Bostik type, located at the internal electrode. The recording instrument was a low-lag, three-layer bolometer, with a bismuth thermal resistance, spray-deposited on aluminum foil from the side opposite to the incident flux and insulated from the foil by a layer of aluminum oxide. The change in the thermal resistance with time, due to heating up of the plate, was measured. (MOW)

7130 MAGNETIC AND CHARGE NEUTRALIZATIONS OF AN ELECTRON BEAM INJECTED INTO A MAGNETO-ACTIVE PLASMA. Rosinskii, S. E.; Rukhlin, V. G. (Inst. of Cosmic Research, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 3, 858-868(Mar 1973). (In Russian).

Magnetic and charge neutralization effects in a cold magnetoactive plasma induced by injection of a low-density electron beam are investigated. An analysis of long-period perturbations (along the beam) shows that the thickness of the column in which the fields and currents in the region of magnetic neutralization are concentrated is the most sensitive to the external magnetic field strength. The thickness increases even at relatively weak field strengths. Conditions are obtained, in particular, under which the field in the magnetic neutralization region changes from one skinned along the beam radius to a quasi-periodic one. In stronger external magnetic fields, the role of ions becomes important. In this case not only the skin depth but also the diffusion length (or distance from head of the beam up to which magnetic neutralization occurs) also varies (decreases). Conditions for absence of magnetic and charge neutralization are found. It is impossible to send super-limiting currents through the plasma (or gas). (auth)

7131 PROPERTIES OF FUSION PLASMAS AND THEIR MEASUREMENT. Elton, R. C. (Naval Research Lab., Washington, DC). IEEE(Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 436-438(Feb 1973).

As an introductory paper to the session on Plasma Research for Fusion Power, it is intended that this paper provide an overview of the research problems and status in this area, with an emphasis on the continuing need for careful diagnostic measurements of the relevant plasma characteristics. (auth)

Kinetics (Theoretical)

7132 (AD-751048) STUDIES IN THE PHYSICS OF X-RAY GENERATION BY LASER-HEATED PLASMAS. Final Report, 1 June 1971–31 July 1972. Tamor, S. (Science Applications, Inc., La Jolla, Calif. (USA)). 7 Jul 1972. Contract DASA01-71-C-0135. 49p. (SAI-72-548-LJ; DNA-2950-F). NTIS.

A discussion of the kinetics of heating radiation of a laser-heated plasma is presented. Estimates are derived for all relevant reaction rates and time scales. It is possible, on the basis of very general considerations, to predict the main features of the x-ray spectrum, the validity of the optically thin approximation, and to obtain a minimum value of the total deposited energy below which no appreciable x-ray conversion is possible. The propagation of the laser light as it approaches the critical density plane is discussed. Since a large fraction of the energy absorption actually occurs at this surface, and it is here that the usual WKB solution fails, some special cases for which exact solution is possible are examined. The final results suggest a simple estimate for the field strength near the critical density plane which is not very sensitive to the finer details of the plasma density profile. (auth)

7133 (AD-751607) STUDY OF EQUATIONS OF STATE/OPACITY OF IONIZED GASES. Volume 1. Final Report, 15 October 1970–15 October 1971. Cohen, H. D.; Vik, R. C. (Systems, Science and Software, La Jolla, Calif.). Oct 1972. Contract DASA01-70-C-0030. 121p. (DNA-2794-F-1). NTIS.

The report discusses the changes that have been made in CAPO since the previous report (AD-722709). CAPO is a program that calculates the equation-of-state, thermodynamic functions, and opacities of plasmas. In addition reports of the following papers are included: Statistical Model of Incoherent x-ray Scattering, on the Compensation Between the Bound State and Continuum Contribution to the Partition Function, and A Continuum Approximate Treatment of Ionization Potential Lowering. (auth)

7134 (AD-751608) STUDY OF EQUATIONS OF STATE/OPACITY OF IONIZED GASES. Volume 2. Appendix D. Segmentation of CAPO. Appendix E. Listing of CAPO. Final Report, 15 October 1970–15 October 1971. Cohen, H. D.; Vik, R. C. (Systems, Science and Software, La Jolla, Calif.). Oct 1972. Contract DASA01-70-C-0030. 151p. (DNA-2794-F-2). NTIS.

A listing is given of the CAPO program, which calculates equations-of-state, thermodynamic functions, and opacities of plasmas. This code is written in UNIVAC 1108 FORTRAN 5 and does not contain the relativistic subroutines. (auth)

7135 (AD-755398) GYRO-SYNCHROTRON RADIATION FORMULAE. Final Report, 1 October 1969–30 September 1972. Ko, H. C. (Ohio State Univ. Research Foundation, Columbus). Nov 1972. Contract F19628-70-C-0019. 17p. (AFCRL-72-722). NTIS.

The wave-normal emissivity and the ray emissivity formulae for an electron moving along a helical path in a magnetoactive medium are presented. Simplified formulas for the case of an isotropic plasma are also given. Because of the helical motion of the electron, one must distinguish between the radiated power per unit solid angle and the received power per unit solid angle. The relation between these two quantities in a magnetoactive medium is shown. The results are compared with those obtained by others, and the sources of discrepancies are pointed out. (auth)

7136 (JUL-CONF-7, pp 61-81) APPLICATIONS OF SIMULATION PROCEDURES IN PLASMA PHYSICS. Walther, H.; Wick, J. (Kernforschungsanlage, Juelich, Ger.). Oct 1972. (In German).

From information conference on date prepared in research; Juelich, Germany (12 Oct 1972).

The discussion includes the Euler procedure, the difference procedure, the Lagrange procedure, the sheet model, the particle cell method, Landau damping, two-stream instability, and the plasma sphere. (HBG)

7137 THERMODYNAMIC BOUNDS ON THE MAGNETIC FLUCTUATION ENERGY IN UNSTABLE ANISOTROPIC PLASMAS. Davidson, R. C.; Tsai, S. T. (Univ. of Maryland, College Park). J. Plasma Phys.; 9: No. 1, 101-116(Feb 1973).

A method for calculating thermodynamic bounds on the field energy in unstable plasmas is generalized to incorporate two energy constraints (in addition to entropy and number conservation). An upper bound on the magnetic fluctuation energy is obtained for arbitrary initial distribution function, and the results are applied to unstable (i) bi-Maxwellian and (ii) loss-cone distributions. Depending on the parameter regime, it is found that the bounds obtained by enforcing two energy constraints can be an order-of-magnitude lower than the bounds obtained by enforcing a single (total) energy constraint. The theoretical bounds are compared with the maximum change in field energy measured in computer simulation experiments for the case where the initial distribution function is bi-Maxwellian. For sufficiently large initial anisotropy, it is found that the bound obtained with two energy constraints is less than 1.5 times the measured change in field energy. (auth)

7138 TRANSFER PHENOMENA IN A COMPLETELY IONIZED ULTRARELATIVISTIC PLASMA. Dzhavakhishvili, D. I.; Tsintsadze, N. L. (Tbilisi State Univ., USSR). Zh. Eksp. Teor. Fiz.; 64: No. 4, 1314-1325(Apr 1973). (In Russian).

A set of transfer equations for a hot relativistic plasma whose particles, may, in particular, possess a thermal energy exceeding the rest energy, is obtained in the presence of electric and magnetic fields. In the limit when the aforementioned condition is satisfied for electrons but the ions remain cold, the transfer coefficients are found for a plasma consisting of electrons and one type of positive ions. It is shown that, in this case, the temperature dependence of the transfer coefficients strongly changes, as does also the hydrodynamic equation set itself. (auth)

7139 DEBYE SCREENING AND EQUATION OF STATE OF A PARTIALLY IONIZED PLASMA. Vorob'ev, V. S.; Khomkin, A. L. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Trans.); 10: No. 5, 848-856(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 5, 939-949(1972).

A partially ionized plasma is described by a modified Hamiltonian obtained from the ordinary electron–ion Coulomb Hamiltonian by means of a canonical transformation. In the zeroth approximation this modified Hamiltonian describes atoms and free electrons and ions. The interaction potential for the latter is not a Coulomb potential. The difference is reflected in the form of the Debye term and in a slower increase in this term with increasing density. The equation of state which follows from this analysis is discussed. (auth)

7140 UNIVERSALITY OF THE POWER SPECTRA OF RELATIVISTIC ELECTRONS PRODUCED IN A TURBULENT PLASMA. Nikolaev, Yu. A.; Tsytovich, V. N.; Chikhachev, A. S. (Moscow Engineering-Physics Inst.). Zh. Eksp. Teor. Fiz.; 64: No. 3, 877-884(Mar 1973). (In Russian).

It is demonstrated that the stationary energy distributions of relativistic electrons in a turbulent plasma located in a magnetic field can be described by a power law $\sim\epsilon^{-\gamma}$. An equation for γ is obtained which takes into account anisotropy of the electron distribution and of the electromagnetic radiation interacting with it in a uniform magnetic field. It is shown that for a distribution function not averaged over directions of the magnetic field there is a single solution of the equation which yields the universal value of γ equal to 3. (auth)

Production

Refer also to abstract 7111.

7141 (AD-755119) INITIAL APPEARANCE OF HIGHLY CHARGED IONS FROM MAGNESIUM SURFACES IRRADIATED BY Q-SWITCHED RUBY PULSES. Stumpfel, C. R.; Robitaille, J. L.; Kunze, H. J. D. (Ballistic Research Labs., Aberdeen Proving Ground, MD). Aug 1972. 27p. (BRL-1619). NTIS.

The time development of line radiation emitted from a plasma produced by focusing a Q-switched ruby laser onto a solid magnesium target was investigated in the vacuum-ultraviolet wavelength region using a 2-m grazing-incidence monochromator. The electron temperature was obtained using the foil-absorption method. The time of appearance of MgIX and MgX ions at the target was measured as a function of the laser power. It was found that, with increasing power, the ions appear earlier, MgIX before MgX, until for the higher powers used they appeared at about the same time, 2 nsec after the beginning of the laser pulse. The ionization processes occurring in front of the target are discussed using a simple model for the plasma. From the time of appearance of the lines conclusions of the electron temperature in the heating zone can be drawn as well as on an overall heating rate. (auth)

7142 THERMAL IONIZATION WAVE IN A SYSTEM WITH A CURRENT. Ivanov, A. A.; Parail, V. V.; Soboleva, T. K. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 4, 1245-1251(Apr 1973). (In Russian).

The creation and propagation of a plasma column on application of a sufficiently strong electric field to a plane layer of a neutral gas are considered. It is shown in the one-dimensional case that, if a finite size plasma layer is initially formed as the result of electric breakdown in a neutral gas, its further expansion may take place with a constant velocity $u \ll c_s$, where c_s is the velocity of sound; in other words, expansion may occur without the formation of a strong shock wave. The rate of expansion of the plasma layer in this case is controlled by diffusion and ionization processes, the combined action of which leads to the possibility of propagation of a stationary wave in the gas. Ionization of the gas by epithermal electrons occurs at the front of the wave. (auth)

7143 EXCITATION AND IONIZATION OF NEUTRAL ATOMS IN A DENSE DISCHARGE. Deutsch, C. (Laboratoire de Physique des Plasmas, Université de Paris, Faculté Des Sciences, 91 Orsay, France). J. Appl. Phys. 44: No. 3, 1142-1145 (Mar 1973).

Closed forms for the electron-impact cross sections are used to evaluate excitation and ionization rates of the ground state of some atoms currently used in discharge physics. A Maxwellian and a Druyvesten distribution are considered respectively for the electron distribution velocity. Excitation processes are seen to be much more dependent on the atomic structure and the electron distribution than on ionization. Conversely, the latter process is much more sensitive to the electron temperature. Estimates of the electron density for the existence of complete local thermodynamic equilibrium are also discussed. (auth)

7144 METHOD AND EQUIPMENT FOR PLASMA PRODUCTION. Foex, M.; Delmas, R.; Bonet, C. (to Agence Nationale de Valorisation de la Recherche). French Patent 2,119,179. 4 Aug 1972. Filed date 23 Dec 1970. 11p. (In French).

An installation is described for the production of an electric arc inside convergent fluid flows and the subsequent production of a principal plasma flow. One of the plasma flows is provided by a pilot plasma generator and the others by adjutages not having their own power supplies. The pilot generator and the adjutages are connected in circuits which are themselves respectively connected in parallel to a single power supply. The pilot generator circuit is provided with a sufficiently large resistance to ensure that most of the current passes through the circuit feeding the adjutages. (FR)

Stability

Refer also to abstracts 5450, 7103, and 7172.

7145 (AD-751341) FEEDBACK CONTROL OF AN UNSTABLE PLASMA. Final Report, 16 September 1969–15 June 1971. Crowley, J. M.; Hendricks, C. D. (Illinois Univ., Urbana. Dept. of Electrical Engineering). June 1972. Contract F33615-70-C-1091. 82p. (ARL-72-83). NTIS.

The application of feedback to the flute modes expected to arise in the ELMAX plasma, a rotating, cylindrical plasma confined in a magnetic mirror device, is discussed. A guiding center model of the plasma is formulated and used in a normal-mode feedback analysis to investigate the stability of the plasma as the characteristics of the feedback loop change. Among the characteristics studied are the exciter geometry, the detector placement, the gain of the feedback amplifier, and the resistor and capacitor values in the compensation circuit. Based on the study, a design procedure for the control of the m = 1 flute mode is formulated and illustrated. (auth)

7146 (AD-753102) MODAL FEEDBACK STABILIZATION OF HYDROMAGNETIC EQUILIBRIA. Rodriquez, G.; Wang, P. K. C. (California Univ., Los Angeles. School of Engineering and Applied Science). Sep 1972. 39p. (UCLA-ENG-7285; AFOSR-TR-72-2290). NTIS.

The problem of feedback stabilization of MHD instabilities is studied. Results are obtained for a cylindrical perfectly conducting plasma column immersed in a static axial magnetic field. Based on the linearized MHD equations, it is shown that local stabilization (including the interchange modes) can be achieved by a feedback control in the form of a magnetic field perturbation acting at the fluid boundary and depending linearly on the amplitudes of the unstable modes only. The control can be implemented by a finite number (a minimum of two in order to control all the unstable modes) of helical current-carrying conducting straps. The interchange modes can be stabilized by shielding each strap such that its field is effective on a portion of the plasma surface only. The limitations of the results are also discussed. (auth)

7147 (AD-754005) INSTABILITY REGIONS FOR DENSITY-GRADIENT-DRIVEN OSCILLATIONS IN FULLY IONIZED MAGNETOPLASMAS. Friz, W.; Franklin, R.; Mueller, G. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Nov 1972. 44p. (ARL-72-153). NTIS.

Results of numerical calculations on the behavior of the low frequency density-gradient-driven drift instability in the collision dominated regime are presented. Real and imaginary parts of the instability frequency are given as a function of the plasma parameters essential for this instability. The calculations are based on a dispersion relation derived from fluid equations applicable to the plasma slab geometry. (auth)

7148 (AD–754019) PLASMA INSTABILITIES. Final Report, July 1965–April 1972. Cramer, K. R. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Aug 1972. 20p. (ARL–72-101). NTIS.

A brief description and results are given of the various research efforts conducted during the period of mid 1965 to April 1972 under an in-house theoretical research program that was supported by a small experimental effort conducted by students from the Air Force Institute of Technology. Also, research contracts with university and industrial scientists supported related efforts. The appendix contains a list of the 55 publications and presentations accomplished under the in-house portion of the program. (auth)

7149 (AD–755730) FINITE-BETA DRIFT ALFVEN INSTABILITY. Chance, M. S.; Coroniti, F. V.; Kennel, C. F. (California Univ., Los Angeles. Plasma Physics Group). Jan 1973. Contract N00014-69-A-0200-4023. 31p. (PPG-141). NTIS.

The theory of drift instabilities is extended to plasmas of arbitrary beta. The drift Alfven instability driven by an electron temperature gradient, proposed by Coroniti and Kennel (1970) to be a source of Pi-1 micropulsations on auroral lines of force, is discussed. Even at relatively low beta, the full finite-beta theory differs considerably from previous low-beta theories and produces better agreement with observation. (auth)

7150 (ORO-2598-6) INSTABILITIES DUE TO ANISOTROPIC VELOCITY DISTRIBUTIONS. Progress Report June 1, 1972–June 1, 1973. Harris, E. G. (Tennessee Univ., Knoxville. Dept. of Physics). 1973. Contract AT(40-1)-2598. 8p. Dep. NTIS $3.00.

Summaries of research work on the following are given: (1) theory of ech, (2) nonlinear saturation of flute-like modes, (3) linear stability of flute-like modes, (4) nonlinear propagation of transverse waves, (5) interaction of laser radiation with plasmas, (6) possible stable nonuniform plasma equilibria, and (7) macroscopic instabilities in Tokamaks. (MOW)

7151 (UCID-16235) GEOMETRIC EFFECTS IN NEUTRAL INJECTION INTO BASEBALL II. Fowler, T. K. (California Univ., Livermore. Lawrence Livermore Lab.). 3 Mar 1973. 21p. Dep. NTIS $3.25.

It has been observed that the Baseball II plasma is more stable after the neutral beam is turned off. This has been true in the past when charge-exchange losses dominated, but it is also true at low injection energies where scattering is dominant. Several possible causes related to the Baseball II geometry are examined. One is the possibility that charge exchange continues to dominate the outer low-density region. Another appears to be the nature of the ion distribution presently being produced by neutral injection in Baseball II. Ion deposition calculations are described. (MOW)

7152 ELECTRIC FIELD FLUCTUATIONS IN TURBULENT PLASMAS. Cook, I.; Taylor, J. B. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). J. Plasma Phys.; 9: No. 1, 131-141(Feb 1973).

It is shown that turbulent fluctuations in a plasma may suppress the growth of the instabilities that give rise to them. The fluctuation spectrum, diffusion coefficient and dielectric constant of turbulent plasma are calculated for the guiding-center model. (auth)

7153 ORDINARY-MODE ELECTROMAGNETIC INSTABILITY FOR COUNTER-STREAMING IONS WITH ANISOTROPIC TEMPERATURES. Gaffey, J. D. (Univ. of California, La Jolla, San Diego); Thompson, W. B.; Liu, C. S. J. Plasma Phys.; 9: No. 1, 17-21(Feb 1973).

The instability of the ordinary electromagnetic mode propagating perpendicular to an external magnetic field is investigated for two ion beams with anisotropic temperatures, counterstreaming along the magnetic field. A necessary and sufficient condition for instability is derived. The growth rate is calculated, and found to be typically several times the ion cyclotron frequency. (auth)

7154 MECHANISM OF DEVELOPMENT OF BEAM INSTABILITY IN A PLASMA. Kurilko, V. I. (Kharkov State Univ.). Dokl. Akad. Nauk SSSR; 208: No. 5, 1059-1061(11 Feb 1973). (In Russian).

Thermal motion does not disturb the coherent radiation in a hydrodynamic approximation, therefore for a quantitative evaluation of the increment of beam instability, the disregard of these effects is inadmissible. It is shown that a calculation of these effects, and also of the reverse influence of the resulting field on the motion of beam particles, permit one to express the hydrodynamic increment through the characteristics of the radiation of an individual electron in a plasma. (KSW)

7155 DEVELOPMENT OF INSTABILITIES IN A Z-PINCH. Osovets, S. M.; Pavlov, E. I.; Sinitsyn, V. I. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 4, 1228-1236 (Apr 1973). (In Russian).

The development of magnetohydrodynamic instabilities of the m = 0 and m = 1 modes is experimentally studied for a linear z-pinch. It is shown that the mode and characteristic wavelength of the instability are mainly determined by the radius of the discharge tube and the rate of current buildup. The results indicate that with a high degree of probability instabilities of the Rayleigh–Taylor type develop under the conditions considered. An analysis of the results performed under such an assumption leads to relations between the instability wavelength and the discharge parameters. The relations are in good agreement with the experimental results. (auth)

7156 NONSTATIONARY THEORY OF DECAY INSTABILITY IN AN INHOMOGENEOUS PLASMA. Piliya, A. D. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz.; 64: No. 4, 1237-1244(Apr 1973). (In Russian).

The time evolution of the amplitudes of two parametrically coupled waves in a weakly inhomogeneous plasma is considered for the case when the oscillations can be described by the geometric optics approximation and the decay conditions are satisfied only in a single resonant plane of the layer. Conditions for existence of a stationary solution are found. They are determined by the imaginary part of the product of the wave-interaction matrix elements. (auth)

7157 GRAVITATIONAL AND TEARING-MODE RESISTIVE PLASMA INSTABILITIES. Cross, M. A. Irvine, CA; Univ. of California (1972). 135p. University Microfilms Order No. 73-11,647.

Thesis (Ph. D.).

The physics of the resistive tearing-mode instability is described for a magnetohydrodynamic sheet pinch, and necessary conditions for its existence are derived. The linear growth rate, ω, is then calculated by a new method. At the fastest-growing (most unstable) wavelength the growth rate with constant resistivity is $\omega = 3.4\, S^{4}/^{7}\, t_r^{-1}$, where S is the magnetic Reynolds number at the Alfvén speed (the ratio of resistive to Alfvén time scales) and t_r is the resistive decay time of the initial magnetic field. The nonlinear tearing mode was also studied by a time-dependent computer solution of the Fourier-transformed MHD equations, starting from the fastest growing linear mode. This method permits an assessment of the number of Fourier terms and the size of the time step required for accuracy. The effects of fluid compressibility and heating are also considered. The fully nonlinear instability is characterized by fluid velocities greater than 15% of the Alfvén speed and energy release of more than 4% to kinetic energy and to the reconnected magnetic field. Less than 92% of the energy in the original magnetic field is converted into thermal energy. Allowing for the limitations imposed by the closed periodic configuration and small values of S, it is shown that the tearing mode could account for the energy released in solar flares on a time scale consistent with observations. The infinite conductivity tearing mode is also studied, and its magnetohydrodynamic applicability discussed. It is found to have a linear growth rate $\omega = 8.5\ (V_a/a) \times (c/a\ \omega_{pe})^{1.5}$, where v_a is the Alfvén speed, a is the transverse scale width of the neutral sheet, and ω_{pe} is the electron plasma frequency. This result is applied to the geomagnetic tail and found to be in rough agreement with the period of magnetospheric substorms. The linear resistive gravitational interchange instability is studied by the same method used for the tearing mode. Its growth rate at short wavelengths is $\omega = SG^{1/3}/t_r$, where G is a dimensionless gravitational acceleration. Several modes and growth rates of this instability are discussed. When resistivity is present we find that it is not possible to shear stabilize the magnetohydrodynamic Rayleigh–Taylor instability. The tearing mode with temperature dependent resistivity is next studied. The linear growth rate is found and the possible induced development of the rippling-mode resistive instability is discussed. (Diss. Abstr. Int., B)

7158 DEVELOPMENT OF THE IONIZATION STABILITY ON A NONSTATIONARY BACKGROUND. Kas'yanov, V. A. (Moscow Power Inst.). High Temp. (USSR) (Engl. Transl.); 10: No. 5, 857-860(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 5, 950-953(1972).

The development of the ionization stability in a weakly ionized plasma during its Joule heating depends strongly on the initial conditions. It is shown in the linear approximation in the fluctuation of the electron density that the development time of the ionization instability may be appreciably shorter than the relaxation time of the electron density at large ratios of the Joule heating to the elastic losses at the initial instant of time. If the predominant mechanism of energy loss by the electron gas is elastic electron–ion collisions, the ionization instability can develop when $\Omega\tau$ is less than $\Omega\tau_c$, the critical Hall parameter for steady-state conditions. (auth)

7159 QUASI-LINEAR THEORY OF A PARAMETRICALLY UNSTABLE MAGNETOACTIVE PLASMA. Pustovalov, V. V.; Silin, V. P.; Tikhonchuk, V. T. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 3, 843-857(Mar 1973). (In Russian).

A quasi-linear theory of a magnetoactive plasma irradiated by an intense beam is developed with the aid of the equation for the pair correlation function of plasma particles. The general points of the theory are illustrated by solving the quasi-linear equation set for the case of an electron oscillation amplitude in the field of the pumping wave which is small compared to the perturbation wave-length of a strongly magnetized plasma at frequencies of the lower hybrid resonance and slow magneto-acoustic waves. The time dependence is obtained for the parametric growth rate, spectral energy density of parametrically excited plasma perturbations and electron distribution function. The appearance of an appreciable number of fast electrons (about a tenth of a percent of the total number) is observed. Turbulent conductivity of a magnetoactive plasma at the pumping wave frequency is great compared to the laminar conductivity due to collisions. (auth)

Thermonuclear Engineering and Equipment

7160 (AD-751294) SOLID DEUTERIUM EVAPORATION IN A FUSION PLASMA. Report No. 58. Gralnick, S. L. (Columbia Univ., New York. Plasma Lab.). Sep 1972. Contract F44620-71-C-0010. 117p. (AFOSR-TR-72-2051). NTIS.

The high-speed ballistic injection of a solid spherical pellet of deuterium into a thermonuclear reactor plasma is studied to determine the feasibility of this technique for controlled thermonuclear reactor fueling. An evaporation wave front is driven into the solid by the ambient particle energy flux which evaporates the surface of the solid. This evaporated pellet material is an ionized plasma whose temperature is initially of the order of 10,000K. About one half of the input power to the pellet is convected away by the expanding warm plasma cloud. This evaporated plasma cloud then helps shield the pellet surface from the incident reactor electrons. The dynamics of this pellet evaporation, the expanding plasma cloud, and its shielding effect are studied in detail. The trajectory of the pellet and the deposition of the evaporated material are analyzed for the case of high-speed injection into a fusion plasma whose density profile is characteristic of a large reactor. Sufficient pellet penetration can be achieved by this means at relatively small power expenditure but very-high-voltage particle acceleration is required to achieve the needed input velocity. (auth)

7161 (LA-5218-MS) OPTIMIZATION OF THE SUPERCONDUCTING SWITCH DESIGN IN A SUPERCONDUCTING MAGNETIC ENERGY STORAGE SYSTEM. Weldon, D. M.; Lindsay, J. D. G.; Laquer, H. L. (Los Alamos Scientific Lab., N. Mex.). Mar 1973. 17p. Dep. NTIS $3.00.

A superconducting magnetic energy storage system switched by normal-going superconductors was recently proposed by Ribe as part of an experiment demonstrating scientific feasibility of a thermonuclear reactor. In this proposal, heating of the plasma was to be accomplished in two stages with a capacitor bank providing the initial shock heating and a magnetic energy storage system switched in later providing most of the heating by adiabatic compression. Each superconducting switch used with the magnetic energy storage system was to be placed in parallel with a protection resistor, operated at room temperature, whose resistance was much smaller than the normal state resistance of the switch. This was to prevent excessive energy loss in the cryogenic environment. It was later suggested by Garwin that if the protection resistor were removed and the mass of the switch reduced, the temperature change of the switch could be made very large so that the subsequent recooling of the switch could be done with higher thermodynamic efficiency. The relative merits of these two modes of operating a superconducting switch have been analyzed including the cost of superconducting materials, operating power for the refrigerator, and capital investment in the refrigerator. In general if both modes of operation are equally acceptable as far as operation of the switch is concerned, the net economic advantage, if any, to allowing the switch to make a large temperature excursion is highly dependent on the physical design of the switch. If proper opening and latching of the switch requires that its mass be small so that the first mode of operation is not acceptable, some form of refrigerator staging can reduce the overall cost of the system. (auth)

7162 MULTIPLE ION SOURCE ARRAY. Gordon, F. J.; Damm, C. C. (to United States Atomic Energy Commission). U. S. Patent 3,723,730. 27 Mar 1973. Filed date 30 Nov 1971. 4p.

Several Calutron ion sources are spaced in a linear array at a 45° angle to a 90° plane, i.e., the plane parallel to the field lines of a uniform magnetic field into which the source beams are directed, and normal to the injection axis of the ion receiving-device, such as an accelerator column. The sources are contained in a common vacuum and respectively operated at a proper potential with respect to the strength of the magnetic field for each beam to enter a single-beam accelerator presented at the plane, at a suitable relatively small acceptance angle, e.g., of the order of ±3°. Not only may the array be employed to introduce a very-high-current beam to the accelerator column, but a composite beam of various elements and/or their isotope ions in admixture may be supplied by the array as desired. (Official Gazette)

7163 BASE-LINE NOISE REDUCTION IN LASER PULSE TRAINS. Thorne, James M.; Loree, Thomas R.; McCall, Gene H. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). Appl. Phys. Lett. 22: No. 5, 259-260 (1 Mar 1973).

The intensity-dependent rotation of elliptically polarized light by carbon disulfide is used to discriminate against low-intensity laser light and pass high-intensity pulses through crossed polarizers. The transmitted intensity is shown to be proportional to the third power of the incident intensity. This technique has been used to reduce base-line noise and low-intensity pulses in the output pulse train of a mode-locked Nd : YAG oscillator. (auth)

7164 NANOSECOND PULSE AMPLIFICATION IN ELECTRON-BEAM-PUMPED CO_2 AMPLIFIERS. Figueira, J. F.; Reichelt, W. H.; Schappert, G. T.; Stratton, T. F.; Fenstermacher, C. A. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Appl. Phys. Lett. 22: No. 5, 216-218 (1 Mar 1973).

Pulse amplification and energy extraction experiments in high-pressure CO_2 amplifiers indicate that the effective rotational time constant for nanosecond energy extraction is an order of magnitude larger than the rotational relaxation time. (auth)

7165 BUMPY TORUS PLASMA CONFINEMENT DEVICE. Dandl, R. A. (to United States Atomic Energy Commission). U. S. Patent 3,728,217. 17 Apr 1973. Filed date 5 Jun 1972. 10p.

A toroidal thermonuclear plasma containment device is provided in which full toroidal plasma confinement is made possible by joining a set of individual segments containing steady-state, high-β, hot electron plasmas, sustained and heated by microwave power, to stabilize a less-energetic toroidally confined plasma component. Each segment comprises a high-β relativistic electron plasma ring that is formed between two canted mirror coils with resonant and upper off-resonant microwave heating when the two mirror coils are pivoted about parallel axes (normal to the mirror axis) by equal but opposite angles to produce the nonaxisymmetric plasma ring. Thus, a bumpy torus is provided which is made magnetohydrodynamically stable by maintaining in each bump of the torus, and outside the toroidal plasma, a high-pressure, relativistic electron plasma ring which is itself stabilized by cold plasma line tying. (Official Gazzette)

7166 NEUTRON PRODUCTION BY HOT DENSE PLASMAS GENERATED WITH HIGH-POWER PULSERS. Young, F. C.; Stephanakis, S. J.; Vitkovitsky, I. M.; Mosher, D. (Naval Research Lab., Washington, DC). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 439-445(Feb 1973).

Neutron production from plasmas generated by relativistic electron-beam and exploding-wire discharges is surveyed. Diagnostics appropriate to distinguishing neutrons produced by acceleration mechanisms from thermonuclear sources are discussed. The results of applying these techniques to exploding-wire plasmas indicate that the dominant neutron source is thermonuclear fusion. (auth)

7167 CONTEMPORARY CAPACITIVE ENERGY STORAGE SYSTEMS. Kemp, E. L. (Los Alamos Scientific Lab., NM). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 446-451(Feb 1973).

Capacitive energy storage is one of the oldest forms of energy storage for pulsed-power requirements. Most energy-storage capacitors are made of Kraft paper and aluminum foil and impregnated with castor oil. A typical capacitor stores ~ 3000 joules at voltage ratings of 5 to 100 kV. Two types of switches are used for capacitor-bank switching, ignitrons, and pressurized spark gaps. Ignitrons are commercially available, have a wide voltage operating range and are easy to trigger. However, they are limited to ~ 20 kV for most applications and they will prefire. Spark gaps can be designed for reliable operation at almost any voltage level but they are rarely commercially available. Most spark gaps do not operate satisfactorily below 50% of their design voltage and they require a more complicated trigger system than ignitrons. Low inductance coaxial cable has been developed for capacitor bank transmission systems. It is relatively inexpensive and commercially available. Parallel plate transmission lines can be designed to accumulate large amounts of current and conduct it to a concentrated load but careful attention must be given to the containment of the magnetic forces involved. Large numbers of ignitrons can be triggered with a simple trigger circuit that will be described. A circuit is also given to automatically trigger a crowbar ignitron. A pulse forming network circuit is presented which uses inductive voltage addition to generate an 800 kA pulse rising in 100 nsec with a pulse length of 500 nsec. (auth)

7168 ENERGY STORAGE: CONTEMPORARY INDUCTIVE SYSTEMS. dePackh, D. C. (Naval Research Lab., Washington, DC). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 452-455(Feb 1973).

Inductive energy-storage systems are reviewed on the basis of efficiency considerations for purely resistive loads and partially or wholly inductive loads. High-energy charging systems, in particular impulsive homopolar generators, are examined. Relative merits of a number of possible switching systems are also considered. In general inductive storage systems are best adapted to loads with a minimum of inductance. High-energy charging systems typically should exhibit efficiencies of the order of 70%. Efficiency on discharge for resistive loads is limited principally by the switch since inherent circuit losses in large systems are small compared with other losses. (auth)

7169 PULSED POWER GENERATORS. Levine, L. S.; Ury, M. G. (Naval Research Lab., Washington, DC). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 456-462 (Feb 1973).

Pulsed power generators are capable of delivering as much as megajoules of energy in pulses of 100 nsec or less. A brief review of the technological approach to this problem is presented as well as the description of three different devices: Gamble II, AURORA, and a small laboratory device designed at NRL. (auth)

7170 PLASMA CONFINEMENT SYSTEMS. Henning, C. D. (Univ. of California, Livermore). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 463-468(Feb 1973).

Present plasma confinement systems are reviewed in order to provide an understanding of the developments necessary for demonstrating the scientific feasibility of controlled thermonuclear fusion. Significantly, these systems have several common features which appear certain to be used in more advanced experiments. These features include high-field superconducting magnets, neutral beam injection, and vacuum techniques. Beyond the suppressing of plasma instabilities, improvements in these technologies will be required to achieve controlled fusion. (auth)

7171 TOWARDS FUSION REACTOR IGNITION: THE ADIABATIC TOROIDAL COMPRESSION SYSTEM. Citrolo, J. C. (Princeton Univ., NJ). Contract AT(11-1)3073. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 469-472 (Feb 1973).

A major problem area in the study of the feasibility of fusion reactors is the attainment of hot dense plasma for experimental study and the determination of a heating scheme to reach ignition conditions in a reactor. Adiabatic compression in minor and major radius of Tokamak configuration plasmas was proposed as a means of reaching this end. The Adiabatic Toroidal Compressor (ATC) was built at the Princeton Plasma Physics Laboratory to determine experimentally the feasibility of this technique. This paper describes the engineering features of this machine. Preliminary results indicate that compression heating is a possible method of assisting reaching fusion ignition temperatures. (auth)

Wave Phenomena

7172 (AD-751538) MODEL EQUATIONS FOR MODE-COUPLING SATURATION IN UNSTABLE PLASMAS. Ott, E.; Manheimer, W. M.; Book, D. L.; Boris, J. P. (Naval Research Lab., Washington, D. C.). Aug 1972. 35p. (NRL-MR-2487). NTIS.

One of the simplest nonlinear effects which is capable of saturating the growth of a linearly unstable wave or spectrum of waves is resonant mode coupling. The process of resonant mode coupling is not itself a dissipation mechanism but simply carries mode energy from an unstable to a stable region of wave number space. When the rate of energy influx from the linear instability is balanced by the rate of out flow from mode coupling one has reached a steady state. A simple, one-dimensional model for instability saturation by mode coupling is described. (auth)

7173 (AD-751594) INVESTIGATION OF NORMAL IONIZING SHOCK WAVES IN ARGON. Hogan, R. J. (Naval Postgraduate School, Monterey, Calif). Jun 1972. 63p. NTIS.

Thesis.

Normal ionizing shock waves in neutral argon gas were generated using a cylindrical theta pinch. Axial propagation of these shock waves was investigated using photoelectric detectors. Magnetic and electrostatic probes were used to give additional information regarding shock structure. The investigation was carried out using steady-state magnetic fields normal to the shock front, with a maximum field of 7200 G. Initial gas pressures ranged from 0.02 to 1.0 torr. The investigations included studies of the effects of initial pressure, magnetic field, and capacitor-bank voltage upon the shock velocity. Included is a brief discussion of the theta pinch along with the current theory of normal ionizing shock waves. (auth)

7174 (AD-751659) STUDY OF IONIZING SHOCK WAVES GENERATED BY A THETA-PINCH IN AN ARGON GAS. O'Shea, M. G. (Naval Postgraduate School, Monterey, Calif.). Jun 1972. 63p. NTIS.

Thesis.

A study was made of shock waves produced in neutral argon gas by a theta-pinch device. From the study, graphs were made of the velocity of the shock wave observed versus the applied magnetic field, the bank voltage of the capacitor bank, and the argon pressure in the plasma chamber. (auth)

7175 (AD-753986) IMPROVED TABULATION OF THE PLASMA DISPERSION FUNCTION AND ITS FIRST DERIVATIVE. Part I. Argument with Positive Imaginary Part. Fettis, H. E.; Caslin, J. C.; Cramer, K. R. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Jul 1972. 425p. (ARL-72-56). NTIS.

A ten-D table of the plasma dispersion function z(x,y) is given that is identically = z(x + iy) together with its first derivative in the complex plane, for x = 0(.1)20 and y = 0(.1)10. (auth)

7176 (AD-754002) IMPROVED TABULATION OF THE PLASMA DISPERSION FUNCTION AND ITS FIRST DERIVATIVE. Part II. Argument with Negative Imaginary Part: Zeros and Saddle Points. Final Report. Fettis, H. E.; Caslin, J. C.; Cramer, K. R. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Jul 1972. 442p. (ARL-72-57). NTIS.

A ten-D table of the plasma dispersion function z(x,y) is given that is identically equal to z(x + iy) together with its first derivative in the complex plane for x = 0(.1)20 and −y = 0(.1)10. Also included are the first 200 zeros of this function and its derivative, as well as the first 200 zeros of the error function to which the above is closely related. (auth)

7177 (AD-755388) LARGE-AMPLITUDE WAVES IN A COLLISIONAL PLASMA WITH AND WITHOUT A MAGNETIC FIELD. Bakshi, P. M. (Boston Coll., Chestnut Hill, Mass. Dept. of Physics). May 1972. Contract F19628-71-C-0078. 21p. (AFCRL-72-292). NTIS.

Exact nonlinear wave solutions are obtained for a cold collisional plasma described by one-fluid equations of motion. By a suitable change of variables the equations become linear and hence easily solvable for the case of constant collision frequencies. The oscillation frequency is slightly reduced, but the maximum attainable field amplitude is almost unaltered. The wave profile is steepened and grows exponentially with a scale distance of the order of the wave displacement in a collision time. The essentially nonlinear problem of velocity dependent collision leads to a slower, algebraic growth. (auth)

7178 SOME PROPERTIES OF LARGE-AMPLITUDE ELECTROSTATIC WAVES (ALLIS MODES). Neel, W. W.; Flynn, R. W. (Univ. of South Florida, Tampa). J. Plasma Phys.; 9: No. 1, 117-130(Feb 1973).

Allis modes are large-amplitude, undamped electrostatic plasma waves, in which the trapped electron distribution is the analytic continuation of the untrapped distribution. As the amplitude of the periodic solutions increases, the frequency decreases and the wavelength increases, leading finally to solitary pulse solutions as a limiting case, reached when an appreciable number of electrons are trapped by the wave. These pulse-like solutions imply a maximum amplitude to Allis modes, and a maximum to the current that they can drive. A simple approximate expression gives the nonlinear properties of Allis modes in terms of the linear properties and the maximum amplitude. (auth)

7179 ABSORPTION AND TRANSFORMATION OF ELECTROSTATIC SURFACE WAVES IN THE TRANSITION LAYER OF A MAGNETOACTIVE PLASMA. Demchenko, V. V.; Zayed, K. E. (Atomic Energy Commission, Cairo). J. Plasma Phys.; 9: No. 1, 33-47(Feb 1973).

Electrostatic surface-wave damping in strongly inhomogeneous magnetoactive plasma with collisions has been investigated. It is demonstrated that such damping occurs at wave frequencies close to the natural (hybrid) frequencies of the plasma oscillations. Dispersion equations and expressions for the damping coefficients of surface waves propagating along (i) the interface of semi-infinite plasmas, (ii) a plane plasma layer, and (iii) a vacuum layer in the plasma, are obtained. The linear transformation of surface waves into longitudinal oscillations (concentrated in the transition layer and directed along the gradient of plasma density) caused by the initial perturbation is also studied. (auth)

7180 DISPERSION CURVES FOR THE GENERALIZED BERNSTEIN MODES. Puri, S.; Leuterer, F.; Tutter, M. (Max Planck-Institut fuer Plasmaphysik, Garching, Ger.). J. Plasma Phys.; 9: No. 1, 89-100(Feb 1973).

Dispersion curves are plotted for the extraordinary branch of the electron- and ion-cyclotron harmonic waves propagating perpendicularly to the static magnetic field in a nonrelativistic, hot Maxwellian plasma, without invoking the electrostatic approximation. It is found that except in the vicinity of the cyclotron harmonics and the hybrid resonances, either the cold-plasma or the approximation are accurate representations of the exact solution. The hybrid resonances of the cold-plasma model become monotonically shrinking regions of low group velocity as the temperature is increased and all discernible evidence of these resonances disappears as the parameters corresponding to the thermonuclear plasmas are approached. (auth)

7181 NONLINEAR INTERACTION BETWEEN ORDINARY ELECTROMAGNETIC MODES. Krishan, S.; Rankin, D.; Selim, A. A. (Univ. of Alberta, Edmonton). J. Plasma Phys.; 9: No. 1, 23-32(Feb 1973).

Resonant interaction between three ordinary modes, modified by electrons streaming parallel to the static magnetic field of a homogeneous plasma, is investigated. The modes propagate perpendicular to the magnetic field. The Hamiltonian approach, which is microscopic in nature, has been used, and the results are valid for arbitrary ratios of Larmor radius to wavelength. (auth)

7182 NONLINEAR LANDAU DAMPING OF A LANGMUIR WAVE PACKET. Ryutov, D. D.; Khudik, V. N. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 64: No. 4, 1252-1260(Apr 1973). (In Russian).

Damping of a Langmuir wave packet due to its interaction with resonant electrons is considered. It is shown that, for a packet with a fixed phase velocity, the front of the envelope becomes increasingly steeper until a discontinuity is formed that "consumes" the packet. Damping of the packet in this case consists in decrease of its wavelength and not in reduction of the amplitude. The decay time is found as the ratio of the packet length to the discontinuity velocity. For a packet with a phase velocity varying in space, the amplitude decreases at all points of the packet and the decay time decreases. If the phase velocity is a random function of the coordinate, the damping again becomes of the "consumer" type. (auth)

7183 SELF-ACTION OF RADIO WAVES IN THE VICINITY OF PLASMA RESONANCE. Vas'kov, V. V.; Gurevich, A. V. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 4, 1272-1282(Apr 1973). (In Russian).

Self-action of a transverse electromagnetic wave on appearance of parametric instability in a plasma is considered. Variation of structure of the wave field in the region of its reflection is investigated. It is shown that, at the initial period of development of the instability, self-action results in deep amplitude and phase modulation of the reflected wave. (auth)

7184 TURNING REGION OF THE POYNTING VECTOR OF A WAVE INCIDENT ON AN INHOMOGENEOUS PLASMA TOWARDS THE DIRECTION OF AN EXTERNAL MAGNETIC FIELD. Al'pert, Ya. L.; Kaufman, R. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 4, 1283-1290(Apr 1973). (In Russian).

Results are presented of a theoretical investigation of the turning region of the Poynting vector $\overline{S}$ of a wave incident on a plane boundary (xy) of a magnetoactive plasma, which is inhomogeneous along the z coordinate toward the direction of the vector of a stationary magnetic field H_0. Two dependences of the electron density N(z) are considered. The frequency of the waves, ω, is much greater than that of the lower-hybrid frequency, ω_L, and also of the gyro- and Langmuir frequencies (Ω_H and Ω_0) of the ions. This permits one to solve the corresponding problem in the quasi-longitudinal approximation valid for an electron (extraordinary) wave excited in a plasma. It is shown that the thickness of the turning region of $\overline{S}$ depends on the gradient of the electron concentration and in the cases under consideration the direction of $\overline{S}$ assumes the maximal value ($z \to \infty$) at distances z from the plasma boundary which vary between 0.1 and 7 wavelengths. The thickness of the region rapidly decreases with increase of the gradient of the electron density. (auth)

7185 EXCITATION OF ION LANGMUIR OSCILLATIONS BY A FAST ION BEAM. Gabovich, M. D.; Goncharov, A. A.; Poritskii, V. Ya.; Protsenko, I. M. (Inst. of Physics, Kiev). Zh. Eksp. Teor. Fiz.; 64: No. 4, 1291-1296(Apr 1973). (In Russian).

Instability of ion Langmuir oscillations in a plasma—fast ion beam system is investigated in a longitudinal magnetic field. It is shown that a helium or argon 1 to 15-keV ion beam passing through its own gas at a pressure of 10^{-4} to 2×10^{-3} mm Hg excites ion Langmuir oscillations of the plasma that they form. Increase of the magnetic field strength leads to suppression of the oscillations. The experimental data are in satisfactory agreement with the results of a theoretical analysis. (auth)

7186 KINETICS OF STIMULATED SCATTERING OF LANGMUIR WAVES BY PLASMA IONS. Breizman, B. N.; Zakharov, V. E.; Musher, S. L. (Computer Center, Nobosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 64: No. 4, 1297-1313(Apr 1973). (In Russian).

The structure of stationary Langmuir turbulence spectra is investigated by taking into account generation of oscillations and their induced scattering by plasma ions. It is shown that, under conditions of the "diffusion" approximation for scattering, the spectrum has the form of thin jets: the oscillation spectral distribution does not vanish on lines or on surfaces in k-space. The results are illustrated by the problem of relaxation of an electron beam in a plasma and of heating of a plasma by an intense electromagnetic wave. The process of establishment of a stationary spectrum is modeled numerically. (auth)

7187 FOCUSING OF EM WAVES IN PLASMAS BY INHOMOGENEOUS MAGNETIC FIELDS. Sodha, M. S.; Chakravarti, A. K.; Phadke, U. P.; Gautama, G. D.; Rattan, I. (Department of Physics, Indian Institute of Technology, New Delhi-110029, India). Appl. Phys. Lett. 22: No. 4, 121-122 (15 Feb 1973).

A new method of focusing electromagnetic (EM) waves in a plasma by means of a radially inhomogeneous magnetic field arrangement has been proposed. It is seen that the beam gets periodically focused in the plasma; for typical parameters, a focusing length of $\sim$ 1.05 cm has been predicted. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 5118, 5963, 6368, and 6393.

7188 (BNL-50336, pp 6-31) STOPPING POWER AND RANGE-ENERGY RELATIONS. Schioett, H. E. (Univ. of Aarhus, Denmark). Feb 1973.

In interaction of energetic charged particles with solids.

When a beam of particles penetrates a thin layer of matter, the particles in the beam lose energy and are scattered away from their initial direction of motion. Here, only so-called random substances, i.e., substances which are amorphous, or where crystal effects (channeling) are not important, are considered. It is often the case that the distributions are rather narrow, and/or nearly gaussian in shape, so that they are characterized fairly well by their mean value, and the standard deviation from the mean. Simple estimates for these quantities are derived in special cases and the estimates are used in deriving range-energy relations. (MHR)

7189 (BNL-50336, pp 186-201) COMPUTER SIMULATION OF RADIATION DAMAGE IN SOLIDS. Torrens, I. M. (CEN, Saclay, France). Feb 1973.

In interaction of energetic charged particles with solids.

The techniques used in atomistic computer simulation of crystalline solids are reviewed breifly. The following topics are discussed: static defect simulations, molecular dynamics, low-energy damage events, and high-energy atomic displacement cascades. (MHR)

7190 (LA-5157-MS) MONTE CARLO PHOTON CODES: MCG AND MCP. Cashwell, E. D.; Neergaard, J. R.; Everett, C. J.; Schrandt, R. G.; Taylor, W. M.; Turner, G. D. (Los Alamos Scientific Lab., N. Mex.). Mar 1973. Contract W-7405-eng-36. 45p. Dep. NTIS $3.00.

A description of the Monte Carlo photon codes, MCG and MCP, is given. Since these codes contain many features in common with the Monte Carlo neutron code MCN, which is described in LA-4751, the details peculiar to processing photons in each of these programs are concentrated on. This report leans heavily on LA-4751 and is intended to be used in conjunction with it when dealing with a photon problem. The parts of the photon codes which are the same as in MCN are clearly indicated. In Part I, an account is given of MCG. This code is suitable for solving a wide variety of gamma transport problems. The physical processes treated are pair production, Compton scattering, and photoelectric absorption. The collision routine assumes photons with energies between 1 keV and 100 MeV. The possible sources, geometry, and output available to the user are described, together with the Monte Carlo methods and cross section data employed. Part II describes MCP, which has a more sophisticated Monte Carlo collision routine for photons of energy 1 keV to 15 MeV colliding with atoms of $Z = 1, 2, \ldots, 94$ at rest. The routine takes account of incoherent and coherent scattering factors, and of the possibility of fluorescent emission following photo-electric absorption, as well as absorption in pair production with local emission of annihilation radiation. In Part III, a sample problem is set up and run using both MCG and MCP, with the complete computer listing displayed in each case. (auth)

7191 (N-70-42026) CAVEAT: REVISED VERSION OF THE GENERAL PURPOSE MONTE CARLO PROGRAM, COHORT. Volume 1. Theory and Techniques. Revised. Byrn, N. R. (Brown Engineering Co., Inc., Huntsville, Ala.). Apr 1970. Contract NAS8-20166. 66p. (NASA-CR-102878; SE-290(Vol.1)(Rev.)). NTIS.

The revision to a general purpose Monte Carlo computer code for neutron, gamma, and secondary gamma radiation transport calculations is presented. The code is written in the FORTRAN 4 language and was run on the IBM 7094, IBM 360, and UNIVAC 1108 computers. CAVEAT is a revised version of the COHORT program, with additional features such as time dependence, real atmosphere model for air transport, variable dimensioning, and, for third generation machines, a pass option which allows complete execution of a given problem, from source particle generation to fluence calculation. (auth)

7192 (N-70-42027) CAVEAT: REVISED VERSION OF THE GENERAL PURPOSE MONTE CARLO PROGRAM, COHORT. Volume 2. Users' Manual. Revised. Byrn, N. R. (Brown Engineering Co., Inc., Huntsville, Ala.). Aug 1969. Contract NAS8-20166. 128p. (NASA-CR-102877; SE-290(Vol.2)(Rev.)). NTIS.

The Users' Manual describes the input format of each of the CAVEAT routines, data file definition, and proper use of the pass option. Suggestions on the proper use of CAVEAT are included. (auth)

7193 (ORNL-TM-4217) MEDICAL X-RAY DOSE ESTIMATION PROGRAM. Progress Report for Period Ending February 28, 1973. Poston, J. W.; Warner, G. G. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 30p. Dep. NTIS $3.50.

During this reporting period, over 400 individual calculations were completed for 4 × 4 cm beams of monoenergetic photons of 30, 55, and 80 keV. These data in the form of computer printouts and on magnetic tape were transmitted to the Bureau of Radiological Health. In addition, the phantom geometry was modified to include a rounded head, the separated legs, a more realistic location for the testes, the relocation of the eye regions, and the resolution of the "two-thyroid" problem. Optimization of the computer code has resulted in the further reduction in running time by more than a factor of two. (auth)

7194 MEASUREMENT OF THE RANGES OF CHARGED PARTICLES IN MATTER. Kanashevich, V. I.; Laptev, S. V.; Rybin, S. N.; Chursin, G. P. (Inst. of Nuclear Physics, Alma Ata, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 1015-1017(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 43-45(1972).

An instrument is described for measuring the range-energy dependence of charged particles in matter. The method consists in measuring the energy spectra of the particles of a cyclotron beam after passage through a set of absorbers of the given substance having a known thickness. (auth)

7195 SPECTRAL AND DOSE CHARACTERISTICS OF SECONDARY ELECTRONS AT THE AIR-SKIN BOUNDARY IN REMOTE γ THERAPY. Vainberg, M. Sh.; Korf, N. N.; Narkevich, B. Ya.; Sterin, A. M. pp 112-117 of Prikladnaya Yadernaya Spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

7196 ANISOTROPY OF THE OUTPUT OF RESONANCE γ QUANTA FROM A SINGLE CRYSTAL OF ALUMINUM. Akkerman, A. F.; Myaken'kaya, G. S. pp 131-134 of Prikladnaya Yadernaya Spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

7197 STUDY OF SCATTERED ELECTRON AND BREMSSTRAHLUNG FIELDS BY THE MONTE CARLO METHOD. Baranov, V. F.; Arutyunov, V. V.; Smirnov, V. V.; Zaitsev, R. Ya.; Zrazhun, A. G. pp 135-141 of Prikladnaya Yadernaya Spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

7198 MEASUREMENT OF ENERGY AND ANGULAR DISTRIBUTIONS OF BACKSCATTERED ELECTRONS FROM A UNIDIRECTIONAL POINT SOURCE. Gruzin, P. L.; Petrikin, Yu. V.; Rodin, A. M.; Aleshin, A. V. pp 142-147 of Prikladnaya Yadernaya Spektroskopiya. Vypusk 3. Latyshev, G. D. (ed.). Moscow; Atomizdat (1972). (In Russian).

7199 EFFECTS IN PROTON BOMBARDMENT OF NaF CRYSTAL. 1. Measurement of Average Projected Range. Kubo, K. (Japan Atomic Energy Research Inst., Tokai). J. Phys. Soc. Jap.; 33: No. 5, 1401-1406(Nov 1972).

NaF crystals were bombarded with protons of energy from 0.6 to 2 MeV at somewhat high temperatures, to produce Na colloid in the proton-penetrated zone. The average projected range of protons was measured by thickness of the colloid layer. The range-energy relation has little effect on the proton channeling and seems to be that for random directions. The microscopic cleavage profile in the beam direction included colored zone, separate colloid layers, microcracks, and turning of the cleavage steps, which appears to have close relation with the effects of resonant $^{19}F(p,\alpha)^{16}O$ reactions as well as the proton penetration itself. Their locations coincide with the range ends of the protons of incident and resonant energies and of the α particles produced at 340.5-keV resonance. Hydrogen and oxygen with protons and α particles may contribute to the occurrence of a local strain to initiate cracks. (auth)

7200 PHOTON FLUENCE CALCULATIONS FOR ESTIMATING DOSE DISTRIBUTION IN THE THORAX. Sidwell, J. M. (Polytechnic, London). Brit. J. Radiol.; 46: No. 545, 360-364 (May 1973).

The reduced density of the lungs causes dose distributions in the thorax to be significantly different from those estimated for a homogeneous phantom, for all photon energies. The Monte Carlo technique was used to establish the effects of lung inhomogeneities directly from the physical properties of the absorption processes. The program is written in FORTRAN and run on an ATLAS computer. The histories of 8960 monoenergetic photons are followed for each field, and absorbed doses are estimated in an array of 819 elements of volume, each being a cube of 2 cm side. Electrons and positrons were assumed to be absorbed at the point of emission, the latter giving rise to two photons, whose opposite directions were chosen at random from an isotropic distribution. Bremsstrahlung, Rayleigh scattering and polarization are all ignored, and dose distributions are calculated at 80 keV and 1.25 MeV, the first corresponding to x-ray therapy conditions and the second to ^{60}Co. A limited field of 14 × 10 cm is used for an example, but multiple field distributions can be obtained by combining single field data. The advantages and further applications of the technique are discussed. (UK)

7201 APPLICATIONS OF MONTE CARLO METHODS IN MEDICAL RADIOLOGY. Burlin, T. E. (Polytechnic, London); Sidwell, J. M.; Wheatley, B. M. (Polytechnic, London). Brit. J. Radiol.; 46: No. 545, 398-399(May 1973).

The power of the Monte Carlo technique for calculating dose distributions and other data relevant to radiotherapy, where inhomogeneities arise from both differences in density and differences in atomic number, is demonstrated by reference to previously published data (Burlin, T. E. et al., Br. J. Radiol., 46: No. 545, 398-399 (May 1973)). It is suggested that the feasibility of using the method depends firstly on the ability to define the multiplicity of input parameters needed for an accurate result. For γ-dose calculations, the most relevant parameter is the electron density distribution which other workers have shown may be measured by Compton scattering. The second factor influencing the feasibility of using Monte Carlo methods is their computing cost. Recently reported work of the authors, cost £50 per run on the ATLAS computer. At least 4 runs are needed to make a reasonable assessment of the absorbed dose distributions for 80 keV photons and over 12 runs for 1.23 MeV photons. It is suggested that these costs probably restrict the method to research projects, but improved computer technology and more restricted calculations may make the technique financially viable in clinical practice. (UK)

7202 ESTIMATION OF PERCENT-DEPTH-DOSE DISTRIBUTION IN SURFACE LAYER. I. ^{60}Co Teletherapeutic Gamma Rays. Okamoto, S.; Amino, S.; Abe, K.; Nishio, H.; Shintani, Y. (Tokyo Medical Coll.). Tokyo Ika Daigaku Zasshi; 30: No. 4, 347-350(Jul 1972). (In Japanese).

The percent depth dose distribution in a simulated skin layer by ^{60}Co teletherapeutic γ-ray was estimated from density measurement of the film set beneath a stepped phantom of polystyrene. Standard percent surface dose estimated was 13% and was not improved by the use of cadmium plate as a secondary electron filter. The surface dose was increased up to 88% when the beam came through a therapy bed made of pressed wood of 3.5 cm thickness. It was also increased with the thickness of cloth just over the phantom. (auth)

7203 DOSIMETRY OF DIFFERENT IRRADIATION MODES OF THE LUMBAL LYMPH NODES WITH ^{60}Co ON THE ALDERSON PHANTOM. Zwicker, H.; Felix, R. (Univ., Bonn). Strahlentherapie; 145: No. 3, 289-298(1973). (In German).

Various methods of irradiating the lumbal lymph nodes are simulated on the Alderson phantom with ^{60}Co gamma radiation. It is demonstrated that the irradiation of the lumbal lymph nodes from dorsal, by 2 oblique fixed fields, can be easily handled and offers the most favorable dose distribution: The spinal cord is exposed to 25 p.c., both kidneys are exposed to only 10 p.c. of the maximum dose, which covers all the lymph nodes surrounding the vertebral body. The breadth of the fields, each tilted towards lateral by 15°, does not exceed 3.5 cm–4 cm. The point of intersection of their central rays is highly shifted forward in the median plane (in a distance of at least 14 cm from the dorsal surface). (GF)

7204 INFLUENCE OF THE VACUUM-TISSUE INTERFACE ON THE DISTRIBUTION OF THE ABSORBED ENERGY IN THE CHARGED PARTICLE TRACK. Kudryashov, E. I.; Marennyi, A. M.; Meshcheryakova, O. M.; Popov, V. I. Kosm. Biol. Med.; 7: No. 3, 30-34(1973). (In Russian).

The influence of the vacuum-tissue interface on the radial distribution of absorbed energy in the heavy charged particle track was studied. The interface effect has been analyzed with respect to the relation between the absorbed energy and the depth of particle penetration for different distances from the track axis. The computation results given in the graphic form make it possible to determine the dose decrease under the influence of the vacuum-tissue interface upon irradiation of thin layers of biosamples with 1 to 500 MeV/nucleon charged particles. (auth)

7205 ANALYTICAL CALCULATION OF RANGES USING AN APPROXIMATE ENERGY DEPENDENCE OF NUCLEAR RETARDATION. Yudin, V. V. Dokl. Akad. Nauk SSSR; 207: No. 2, 325-326(11 Nov 1972). (In Russian).

The mathematical difficulty of the analytical approach to the problem of ion ranges in amorphous substances lies in the absence of a simple form of the energy dependence of the specific energy loss by nuclear retardation for the potential of Thomas-Fermi interatomic interaction. A differential expression was used for computing the average range, assuming a mutual independence of the specific energy loss. A comparison of the results with data from other workers was made. (KSW)

Radiation Protection Standards

7206 (ORNL-NSIC-108) PERSONNEL INVOLVED IN THE DEVELOPMENT OF NUCLEAR STANDARDS IN THE UNITED STATES, 1972. Blakely, J. P. (Oak Ridge National Lab., Tenn.). May 1973. 478p. Dep. NTIS $15.00.

Personnel made known to the status and recommendations committee during the latter half of 1972 are listed. All information in the Directory is sorted three ways. First is an alphabetical listing by personal name, showing each individual's company name and address and the standards committee(s) he is working on. Next is an alphabetical listing by company (or other organization) name, showing all known standards-active employees and their committees. An alphabetical listing of standards-generating organizations and committee titles (as appropriate), showing all (known) persons working on any given activity is presented. Last is the key-word in context index listing the titles of all standard organizations, committees, subcommittees, and tasks included in this Directory. (MHR)

7207 EUROPEAN COMMUNITIES DIRECTIVE ON THE BASIC STANDARDS OF PROTECTION. Dunster, H. J. (National Radiological Protection Board, Harwell, Eng.). Radiol. Prot. Bull.; No. 3, 3-5(Apr 1973).

A brief general discussion is presented in relation to the present Directive of the E.E.C. Council of Ministers concerning radiological protection, and the new draft Directive in the course of preparation. It is pointed out that there is an understanding that earlier obsolete directives will not have to be applied by the three new member states. An outline description of the form of the directives is presented, and the following topics mentioned: (1) The general form of the directives, and regulatory action taken by reporting, notification, prior authorization etc. (2) Maximum permissible doses, dose limits and their relation to ICRP recommendations, (3) Practical implementation of the directives, including the difficulty of enforcing British non-statutory codes of practice, (4) Harmonization of legislation in the field of radiation protection between the member states of the E.E.C. (UK)

Radiation Source Calibration and Standardization

7208 (ORNL-4788) SOME RADIOISOTOPE ASSAY METHODS. Reynolds, S. A. (Oak Ridge National Lab., Tenn.). Mar 1973. Contract W-7405-eng-26. 29p. Dep. NTIS $4.00.

A review is presented of over a quarter-century of work in calibrations for ORNL radioisotope products. Internal standardizations are surveyed, and details are given of measurements of materials produced by standardizing laboratories, particularly the National Bureau of Standards (NBS). The need for reliable nuclear data is stressed. Specific information, historical as well as current, is included on eight representative products. General suggestions are made for the benefit of others who are required to measure radionuclides. Items included are standards, personnel, equipment, and quality control. (auth)

Shielding Calculations and Experiments

Refer also to abstracts 7332, 7339, 7364, 7390, 7437, and 7449.

7209 (ORNL-RSIC-31(Vol. 1)) ABSTRACTS OF PERIPHERAL SHIELDING CODE PACKAGES ASSEMBLED BY THE RADIATION SHIELDING INFORMATION CENTER. Maskewitz,

B. F. (Oak Ridge National Lab., Tenn.). [nd]. 108p. Dep. NTIS $7.50.

A description of computer code packages considered to be useful in shielding research is presented. The descriptions include name and title of code, contributor, coding language and computer, nature of problem solved, method of solution, restrictions or limitations, typical running time, hardware and software requirements, references, and instructions for obtaining the code package. (CES)

7210 (RT/FIMA-(72)8) ATTOW-B: A NEW VERSION OF REMOVAL DIFFUSION SHIELDING CODE ATTOW. Daneri, A.; Martelli, L.; Toselli, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 21 Dec 1972. 73p. Dep. NTIS (U. S. Sales Only) $5.75.

The modified version of the ATTOW code, ATTOW-B, is described. This version was set up at the Centro di Calcolo of the CNEN, Bologna, for the IBM/7094 computer. The ATTOW-B code effects shielding calculations by the removal–diffusion method for bidimensional shields in R–Z geometry. Contrary to the original ATTOW code, this version provides the total neutron flux, which is utilized for the probable activation calculation. (1 figure) (auth)

7211 BETON V ZASHCHITE YADERNYKH USTANOVOK. (Concrete in Shielding of Nuclear Installations). Broder, D. L.; Zaitsev, L. N.; Komochkov, M. M.; Sychev, V. S.; Mal'kov, V. V. Moscow; Atomizdat (1973). 320p.

Calculations of biological shielding for nuclear reactors and particle accelerators represent the chief topic of discussion of this book. Supplementing the examples of calculations are 126 tables of data and 115 figures and graphs useful in solving shielding problems. Boron-containing concrete and other concretes are discussed. The passage of low- and high-energy neutrons through concrete is examined in detail. Special consideration is given to radiation heating of concrete shielding. 342 references. (KSW)

PHYSICS (THEORETICAL)

General

Refer also to abstracts 6847, 6860, and 6894.

7212 SEPARATION OF VARIABLES IN THE BETHE–SALPETER EQUATION IN MINKOWSKI SPACE. Verdiev, I. A. (Inst. of Physics, Baku). Yadern. Fiz.; 17: No. 3, 643-659(Mar 1973). (In Russian).

A method is being proposed to separate the variables in Bethe–Salpeter equation in Minkowski space. Full systems of the functions were obtained in the polar coordinate system outside and inside the light cone. Expansion of wave and Green functions as well as of propagator was performed. Differential-difference equations of the second order were obtained for partial wave functions. The proposed approach firstly removes known limits imposed by Wick-rotation, secondly it avoids the problem of analytical continuation. (auth)

7213 SEMICOHERENT STATES. Boiteux, M.; Levelut, A. (Univ., Paris). J. Phys., A (London); 6: No. 5, 589-596(May 1973).

The set $|\alpha,n) = D(\alpha)|n>$ is studied at fixed n, where $D(\alpha)$ is the Glauber displacement operator for bosons. Specifically, a closure relation is demonstrated and used for the description of operators in a generalized P representation. The results are applied to some equations of evolution which then appear in a near-classical form. (auth)

7214 WKB APPROXIMATION IN FRAMEWORK OF EXPONENTIAL METHOD. Kolkunov, V. A.; Mel'nikov, V. N. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 17: No. 4, 866-876(Apr 1973). (In Russian).

Properties of the WKB approximation in vicinity of a simple classic turning point are studied using the exponential method. Principal shortcomings of the WKB method are found and their causes are explained. A new method for approximate solution of one-dimensional Schrödinger equation is proposed. (auth)

7215 THEORY OF MEASUREMENT IN QUANTUM MECHANICS. Reece, G. (Imperial Coll. of Science and Tech., London). Int. J. Theor. Phys.; 7: No. 1-2, 81-117(Feb 1973).

The problem of measurement in quantum mechanics is defined and the various attempts made within a statistical framework to give a coherent solution are outlined. The solutions which have looked beyond the statistical viewpoint are described, and the extent to which a solution will emerge on these lines forms the main part of the discussion. An annotated bibliography is included. (UK)

7216 LOGICAL ANALYSIS OF PHYSICAL THEORIES. Dalla Chiara Scabia, M. L.; Toraldo di Francia, G. (Univ., Florence). Riv. Nuovo Cim.; 3: No. 1, 1-20(1973).

The discussion of physical theories covers observational versus theoretical terms, a first approach to physical quantities, a more nearly correct definition of a physical quantity, the laws of physics, and circularity, convention, and truth in physics. (JFP)

7217 PADE APPROXIMANTS AND THEIR APPLICATIONS. Proceedings of a Conference Held at Canterbury, England, July 17–21, 1972. Graves-Morris, P. R. (ed.). London; Academic Press Inc. (London) Ltd. (1973). 357p. (CONF-720612–). £ 5.50.

From conference on Padé approximants; Canterbury, UK (17 Jul 1972).

Thirty-seven papers were presented in sections entitled: mathematical properties of Padé approximants (including papers on: variational principles and Padé approximants; Padé approximants and Hilbert spaces); numerical analysis and numerical methods; critical phenomena and Padé approximants; atomic, nuclear and particle physics and Padé approximants (application of the moment problem, the moment problem and stable extrapolations with an application to forward Kp dispersion relations, application of Padé approximants in the three-body problem, Padé approximants in potential scattering, Padé approximants and the Lippmann-Schwinger equation. Padé approximants in quantum field theory; model field theories and Padé approximants, Padé approximants in nucleon–nucleon dynamics); simulation and control. Two papers in the section covering mathematical properties, and eight papers in the section covering atomic, nuclear and particle physics were in NSA scope, and separate abstracts were prepared for them. (UK)

For abstracts of individual papers see: 6752, 6753, 6830, 6847, 6859, 6860, 6882, and 7218–7220.

7218 VARIATIONAL PRINCIPLES AND PADE APPROXIMANTS. Nuttall, J. (Texas A and M Univ., College Station). pp 29-40 of Padé Approximants and Their Applications. Graves-Morris, P. R. (ed.). London; Academic Press Inc. (London) Ltd. (1973).

From conference on Padé approximants; Canterbury, UK (17 Jul 1972). See CONF-720612–.

It is stated that variational principles have been of great value as a means of deriving approximate methods for the numerical solution of differential equations that appear in physics, and that Padé approximants also show promise of being helpful in solving a number of difficult computational problems. Several important types of variational principles are reviewed, taking as an example the case of quantum mechanics, where a Hamiltonian operator H (self-adjoint) acts in some Hilbert space. The Rayleigh-Ritz Method, the Inhomogeneous Rayleigh-Ritz Method and the Schwinger Method are considered. The Schwinger Method is used to illustrate the connection between Padé approximants and approximations derived from variational principles. (UK)

7219 PADE APPROXIMANTS AND HILBERT SPACES. Masson, D. (Univ. of Toronto). pp 41-52 of Padé Approximants and Their Applications. Graves-Morris, P. R. (ed.). London; Academic Press Inc. (London) Ltc. (1973).

From conference on Padé approximants; Canterbury, UK (17 Jul 1972). See CONF-720612–.

It is stated that there exists a close connection between the theory of the classical moment problem and Padé approximants or continued fractions, and the theory of operators in a Hilbert space. The applications have a foundational aspect (it can be proved that certain operators of quantum theory are self-adjoint) and a numerical aspect (approximation methods for solving of eigenvalue problems and scattering problems). The paper considers Jacobi matrices, and the case of a general symmetric operator. A description is given of three types of applications to problems in quantum theory: self-adjointness of Hamiltonians; eigenvalue calculations; time independent Lippmann-Schwinger type equations of scattering theory. (UK)

7220 PADE APPROXIMANTS AND THE LIPPMANN–SCHWINGER EQUATION. Graves-Morris, P. R.; Rennison, J. F. (Univ. of Kent, Canterbury, Eng.). pp 271-274 of Padé Approximants and Their Applications. Graves-Morris, P. R. (ed.). London; Academic Press Inc. (London) Ltc. (1973).

From conference on Padé approximants; Canterbury, UK (17 Jul 1972). See CONF-720612–.

The relation of Padé approximants to the solution of the partial wave Lippmann-Schwinger equation for the K-matrix is discussed. Methods of establishing meromorphy are outlined: Hilbert space methods; subtraction and symmetrisation methods; Poincare's theorem applied to the Schroedinger equation to show that the Jost solutions and Jost functions of non-singular potentials are analytic in g, and hence that the S-matrix is meromorphic; Banach space methods. (UK)

7221 GENERALIZED INTEGRATION PROCEDURE FOR DIVERGENT INTEGRALS. Caianiello, E. R. (Consiglio Nazionale delle Richerche, Arco Felice, Italy). Nuovo Cim.; 15A: No. 2, 145-161(22 May 1973).

A new definition of integral is proposed, which is based on a direct generalization of the standard Darboux sums; the new integral reduces to the ordinary one whenever the latter exists, to the partie-finie integral introduced by Hadamard (and later defined, equivalently, by many other authors, e.g. through methods of analytic regularization) otherwise. The integral, for which it is deemed appropriate to retain the name of finite-part integral, must be defined for each specific class of singular integrands to be dealt with; this is sufficient to cope with all physical situations of interest, e.g. motion in general relativity, or ultraviolet divergences in quantum field theories; general criteria for doing so are indicated. The aim of this work is twofold: to provide the basis for a generalized, "quasi-local" theory of integration, and at the same time to supply an effective tool for actual use on the computer. For the latter reason, only the Riemann integral is considered in our generalization, Lebesgue integration being unfit for computer use (although theoretically better suited for the application of our concepts). The presentation is oriented mainly toward application. (auth)

7222 DECAY PROBLEM IN NONRELATIVISTIC QUANTUM MECHANICS. Grinberg, Ya. S. (Novosibirsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 38-43(1972). (In Russian).

Schroedinger's time dependent equation was solved using an arbitrary potential of the ultimate radius of interaction. Outside the interaction radius of potential there was obtained a universal solution, independent of the initial state, and describing the evolution of the resonance state. The various space–time regions were investigated in a single-resonance approximation, in which an exponential decay law was observed. (tr-auth)

Quantum Field Theories

Refer also to abstracts 6752, 6753, 6777, 6805, 6871, 6874, 6888, and 7249.

7223 (ITF-73-4-P) WIGHTMAN FIELD AS A CONCENTRATABLE FUNCTIONAL. Lomsadze, Yu. M.; Krivskii, I. Yu.; Shuba, I. M. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 15p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The problem of experimental verification of physically meaningful axioms of the quantum field theory and the difficulties of solving it, caused by the necessity of postulating the belonging of the Wightman field $\varphi(f)$ to a certain class of functionals without a physical justification, are discussed. General restrictions on the domain of the field $\varphi(f)$ as a functional are established. The notion of the concentratable field as the functional $\varphi(f)$, admitting the formulation of the local properties, is introduced. The class of concentratable field is essentially wider than the class of fields being the tempered distributions. (auth)

7224 (ITF-73-18-P) PROPERTIES OF THE WIGHTMAN FUNCTION IN THE NONPOLYNOMIAL LAGRANGE FIELD THEORY. Suyarov, U. S.; Hodzhaev, L. Sh. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The questions concerning the multiplication of the superpropagators in the localizable nonpolynomial Lagrange quantum field theory are considered. A subtraction procedure is developed, and the existence of the invariant, rigorously localizable, general Wightman function is proved. (auth)

7225 (LNF-72/103) CONFORMAL COVARIANT WILSON EXPANSION IN PERTURBATION THEORY. Ferrara, S.; Grillo, A. F.; Parisi, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 6 Dec 1972. 10p. Dep. NTIS (U.S. Sales Only) $3.00.

The Wilson expansion at light-like distances is investigated in perturbation theory. Ward identities for broken conformal symmetry are used: it is found that, for any value of the physical coupling constant, the Wilson expansion is asymptotically conformal covariant depending on the existence of a nontrivial scale invariant skeleton theory. (auth)

7226 (LNF-73/1) RENORMALIZABILITY OF NOT RENORMALIZABLE THEORIES. Parisi, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 8 Jan 1973. 4p. Dep. NTIS (U.S. Sales Only) $3.00.

The unphysical case of a $g\phi^3$ theory in D dimensions, where D is a noninteger number greater than 6, is considered. The theory is superrenormalizable if $D < 6$, renormalizable if $D = 6$, and not renormalizable if $D > 6$. The sum of all the ladder diagrams for the scattering amplitude in a particular kinematical situation is studied. (JFP)

7227 DETERMINATION OF THE FIELD OPERATOR REPRESENTATION IN CANONICAL MODEL QUANTUM FIELD THEORY. Truong, T. T. (Columbia Univ., New York). Nuovo Cim. A; 14: No. 4, 781-811(21 Apr 1973).

In a canonical quantum field theory, i.e., based on the canonical commutation relations, the choice of an adequate field operator representation compatible with an assumed model of interaction is quite difficult to construct, unless the so-called vacuum expectation functional of the field $E(f,g) = \langle\Omega|U^+(f,g)|\Omega\rangle$ is known. Here $|\Omega\rangle$ is the vacuum state of the representation, $U(f,g)$ is the Weyl operator of a neutral scalar field. A determination of $E(f,g)$ in a quartic self-interaction model is proposed as the invariant, positive and normalized function under the action of a system of partial differential functional operators, which form a representation of the Poincaré-group generators. (auth)

7228 SPINOR FIELD AS THE FUSION OF TENSOR FIELDS. Zhelnorovich, V. A. (Moscow State Univ.). Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 13: No. 6, 705-714(1972). (In Russian).

A complete system of scalar and tensor characteristics was established for two spinors in Minkowski space. An equivalent tensor description of the Dirac equations and the Pauli-Yang-Li equations was obtained. The tensor differential equations obtained were linear. It was shown that a field, described by Dirac equations, might be treated as a fusion of different, complex, scalar, vector, pseudovector, and pseudoscalar wave fields. (tr-auth)

7229 EINSTEIN: A NATURAL COMPLETION OF NEWTON. Ramakrishnan, A. (MATISCIENCE, Madras). J. Math. Anal. Appl.; 42: No. 2, 377-380(May 1973).

Einstein relativity theory is presented as a natural continuance and completion of newtonian ideas using the velocity transformation formula. (JFP)

7230 SPACE–TIME MICROSTRUCTURE AND SINGULARITY-FREE QUANTUM FIELD THEORY. Rosen, G. (Drexel Univ., Philadelphia). Int. J. Theor. Phys.; 7: No. 1-2, 145-148(Feb 1973).

It is shown that the dynamical consistency requirements of quantum field theory and the Lorentz-invariant character of particle kinematics and wave equations are compatible with the postulate that physical space is a complex manifold with Euclidean-Gaussian measure in the small. Such a postulate for the microstructure of space introduces a fundamental length $\lambda(\gtrsim 10^{-16}$ cm) and leads to Δ-functions that are analytic on the light-cone for a free field, and hence to self-energies and renormalization constants that are finite for interacting fields. (auth)

7231 MODEL FOR QUANTUM ELECTRODYNAMICS. Manoukian, E. B. (Univ. of Alberta, Edmonton). Lett. Nuovo Cim.; 6: No. 16, 639-642(21 Apr 1973).

A finite model for quantum electrodynamics is set up in a nonperturbative manner. The model theory consists of setting up a particular solution of the Ward-Takahashi identity for the vertex function, supplementing the latter by the usual boundary conditions on $S(p)$ and $D(q^2)$, and studying its consequences by substituting it in the various parts of the theory. (LBS)

7232 VECTOR-PARAMETER AND CALCULATION OF MATRIX ELEMENTS IN ELECTRODYNAMICS. Fedorov, F. I. (Inst. of Physics, Minsk). Yadern. Fiz.; 17: No. 4, 882-888 (Apr 1973). (In Russian).

It is shown that the product of even numbers of the operators $\hat{a} = a_k\gamma^k$ (γ^k are the Dirac matrices) is expressed through the transformation of the Lorentz group representation into bispinor space. Based on this property and on the composition law of the complex vector-parameters of the Lorentz group a new method is developed for the calculation of the matrix elements of quantum electrodynamics processes which allows one to decrease the calculations essentially. (auth)

7233 IRREDUCIBLE REPRESENTATIONS OF A PARAFIELD AND THE CONNECTION OF THE PARAFIELD WITH USUAL FIELDS. Govorkov, A. B. (Joint Inst. for Nuclear Research, Dubna, USSR). Int. J. Theor. Phys.; 7: No. 1-2, 49-66(Feb 1973).

All irreducible separable representations of the nonrelativistic para-Fermi field of order 3 in the configuration space are considered. The existence of many different irreducible representations of the parafield permits us to interpret the excited states of this field as the states of particles with internal degrees of freedom. These states can be labelled by the Young patterns and the eigenvalues of internal quantum number like baryonic and hypercharges. The parafield theory is shown to be equivalent to the theory of three kinds of ordinary fermions, like quarks, and one of them, "strange", can be distinguished from the other two by means of its interaction, not only statistically but also dynamically. Thus the parafield theory is shown to be equivalent to some model of the physical SU(3) symmetry of hadrons when the strong and medium-strong interactions could be switched on, but the electromagnetic and weak interactions should be switched off. (auth)

7234 EXPLANATION OF THE CLOCK PARADOX. Preddy, W. S. (Lanchester Polytechnic, Coventry, Eng.). J. Phys., A (London); 6: No. 5, 615-618(May 1973).

A simple explanation of the clock paradox of special relativity is obtained by considering the aberration of light. (auth)

7235 QUANTUM FIELD THEORY OF FERMIONS CONSTRUCTED FROM BOSONS. Generalization to Para-Fermi Statistics. Kalnay, A. J.; MacCotrina, E.; Kademova, K. V. (Instituto Venezolano de Investigaciones Cientificas, Caracas). Int. J. Theor. Phys.; 7: No. 1-2, 9-24(Feb 1973).

It is proved that Fermi fields can, in principle, be constructed in terms of Bose fields, without losing any of the physical properties of the Fermi fields such as, for example, Pauli's principle.

As an example, a Fermi field satisfying Dirac's equation is constructed in terms of Bose fields. Para-Fermi fields are constructed as well. Consequences: physical theories can, in principle, be reformulated in such a way that fermions and para-fermions are described in terms of bosons. (auth)

7236 IS THERE A BREAK-DOWN OF EQUAL-TIME CANONICAL COMMUTATION RULES? Soln, J. (Univ. of Oregon, Eugene). Nuovo Cim.; 15A: No. 2, 293-298(21 May 1973).

Hieu's recent report of the breakdown of equal-time canonical commutation relations for field operators is reexamined. It is shown that, if the Bjorken–Johnson–Low definition of equal-time commutators is used, the breakdown is avoided. (auth)

7237 NONLINEAR ELECTROMAGNETIC THEORY. Bredimas, A. (Univ., Paris). Lett. Nuovo Cim.; 6: No. 14, 569-572 (7 Apr 1973). (In French).

The total Lagrangian of the nonlinear electromagnetic theory studied is $\Lambda^* = \Lambda + \lambda A^{\rho}_{,\rho}$, where λ is a Lagrange multiplier and $\Lambda = \phi_{\rho\sigma}(\phi^{\rho\sigma}/A^{\pi}A_{\pi})$ where $\phi_{\rho\sigma} = A_{\rho,\sigma} - A_{\sigma,\rho}$. It is assumed that, if there exist some solutions for the formal field equations deduced from Λ^* with λ = const, then these equations are derived from one Lagrangian Λ as if the A^{μ} were independent. It is shown that the nonlinear theory considered enables definition of two real, conservative 4-vector density-currents, ζ^{μ} and J^{μ}. One can deduce that the Lorentz force is in equilibrium with a force of "self-equilibrium;" hence, an electric configuration, given by J^{μ}, is in equilibrium (as in the electron case) in spite of the fact that J^{μ} and ϕ^{μ} are not zero. This theory is then compared with previous theories, such as de Broglie's theory of the electron. It is found that, each time that one is able to describe the field equations in the generalized covariant form (the electric field being preponderant), the two theories will give analogous results, since they are governed by equations analogous in form. If $1 \gg k^{\rho}k_{\rho} = k_0^2 = (\text{photon mass})^2$, then the field equations are exactly the equations of de Broglie's theory of the photon. On the other hand, if one chooses the Dirac gauge, this nonlinear electromagnetic theory reduces to the classical theory of electrons formulated by Dirac in 1951. (RWR)

7238 FIELDS NONLOCAL IN CLIFFORD SPACE. 2. Danos, M. (National Bureau of Standards, Washington, DC); Greiner, W.; Rafelski, J. Z. Phys.; 258: No. 2, 147-162(1973).

A previously proposed field theory is quantized. The theory contains a parameter having the character of an elementary length. The value of this parameter is fixed by scaling it to the weak interaction strength. It is shown that this way negative metric states are confined to a region of the order 10^{15} cm. The resulting quantum theory of interacting fields is Lorentz and gauge invariant, has a unitary S-matrix, and is convergent. (orig) (GF)

7239 DIAGRAMS IN GENERAL PERTURBATION THEORY FOR A NONDEGENERATE STATE. Kiselev, A. A.; Popov, V. N. Vestn. Leningrad. Univ., Fiz., No. 22, Khim.; No. 4, 31-40(Nov 1972). (In Russian).

Diagrams for the eigenfunction and eigenvalue perturbation expansions are used in the time-dependent perturbation theory. Divergent diagrams are expressed in terms of unlinked diagrams and cancellation of the divergencies is shown by means of a theorem analogous to the linked cluster theorem of the many-body perturbation theory. (auth)

Gravitation and General Relativity

Refer also to abstracts 6621, 6718, 6777, and 6805.

7240 (ITF-72-90-E) SENSITIVITY OF GRAVITATIONAL DETECTOR WITH PASSIVE TRANSDUCER. Braginskii, V. B.; Rudenko, V. N. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 13p. Dep. NTIS (U. S. Sales Only) $3.00.

The different gravitational antennas with passive electromechanical transducers are analyzed in the domain of reception of short radiation pulses. The case of coincidence of the electrical and mechanical partial frequencies is discussed. It is shown that the optimal electromechanical coupling in the case of large difference of relaxation times $\tau_e^* \ll \tau_\mu^*$ provides sensitivity $\tau_\mu^*/2\tau_e^*$ times worse than the potential sensitivity of a gravitational detector. (auth)

7241 (ITF-73-11-P) NARIAI CONDITIONS IN GENERAL RELATIVITY THEORY. Denisov, V. I. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 8p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

It is proved that subsidiary conditions obtained by Nariai to which discontinuities of the derivatives $\partial g_{ik}/\partial xd$ and discontinuities of the energy-momentum tensor of the matter T_{ik} should satisfy, are trivially carried out if a discontinuity of the derivatives $\partial g_{ik}/\partial xd$ is longitudinal. It is shown that Nariai conditions are not trivial only in the case when a hypersurface of a discontinuity of the derivatives $\partial g_{ik}/\partial xd$ is isotropic and it has a transverse part. (auth)

7242 (ITF-73-12-P) DISCONTINUITY OF METRIC TENSOR DERIVATIVES OF THE SPHERICALLY-SYMMETRICAL SPACE-TIME. Denisov, V. I. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 6p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

The questions of continuity of metric tensor derivatives of the spherically-symmetrical space-time are studied. (auth)

7243 (ITF-73-25-P) REMOVABLE DISCONTINUITIES OF THE FIRST DERIVATIVES OF METRIC SPACE–TIME TENSOR. Denisov, V. I. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 8p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

The question of removable discontinuities of the first derivatives of metric space–time tensor is considered. It is proved that the longitudinal part of discontinuity of the derivatives $\partial g_{ik}/\partial xd$ can be removed by the transformation of coordinates, which has a discontinuity of the second derivatives of transformation functions. A class of transformations removing the longitudinal part of discontinuity of the derivatives $\partial g_{ik}/\partial xd$ is constructed. These transformations possess the property of being different from the identity in some neighborhood of the hypersurface discontinuity. (auth)

7244 (ITF-73-26-P) STATIONARY FRAMES OF REFERENCE. Usenko, K. V. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 30p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.50.

The frame of reference is defined as an exfoliation of the space of events in a family of geodetically parallel space like hypersurfaces. The conditions under which the group of motions of three-dimensional space is conserved in time are considered. The metrics are defined for the space of maximal mobility. (auth)

7245 EQUATION FOR GRAVITATIONAL WAVES IN TERMS OF THE RIEMANN TENSOR. Lopez, C. A. (Univ. de Chile, Santiago). Lett. Nuovo Cim.; 6: No. 15, 608-610(14 Apr 1973).

An analogy between the field equations of electromagnetism and gravitation is used to obtain the gravitational wave equation in terms of the Riemann tensor. (LBS)

7246 ANTIGRAVITATION AND ELECTRIC CHARGE. Gorelik, G. E. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 13: No. 6, 727-728(1972). (In Russian).

The property of the antigravitation of an electric charge is considered; not the trivial "antigravitation" which corresponds to the repulsion of like charges, but rather the behavior of a neutral particle in a field of a charged particle within the framework of the general theory of relativity. The development begins with the Nordstrom–Reissner solution to Einstein's equations outside of the spherically symmetric electrically charged distribution of matter. The results have an astrophysical significance to the gravitational defect of mass as viewed by an external observer. (KSW)

7247 FIELD THEORY OF GRAVITATIONAL FIELD SOURCES. Rumer, Yu. B.; Konopel'chenko, B. G. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 64: No. 4, 1119-1127(Apr 1973). (In Russian).

It is shown that the analogy between gravitational and electromagnetic fields inherent in the equations of the theory of gravitation may be considerably extended by attaching a physical meaning to the geometric quantities encountered in the theory of nested Riemann spaces. (auth)

7248 EQUIVALENCE OF MASSIVE BRANS–DICKE AND EINSTEIN THEORIES OF GRAVITATION. Acharya, R.; Hogan, P. A. (Dublin Inst. for Advanced Studies). Lett. Nuovo Cim.; 6: No. 16, 668-672(21 Apr 1973).

A general class of Brans–Dicke massive theories is derived in which a finite mass is introduced for the scalar field. The theories each involve a coupling constant ω and in the linear approximation lead to a Fujii-type gravitational potential dependent on ω. It is shown that the classical tests are incapable of distinguishing the massive Brans–Dicke theories from Einstein's theory. (LBS)

7249 EINSTEIN–MAXWELL NULL FIELDS WITH NONZERO TWIST. Goodinson, P. A.; Newing, R. A. (Queen Elizabeth Coll., London). Int. J. Theor. Phys.; 7: No. 1-2, 25-30(Feb 1973).

It is shown that if l_a^0 is the propagation vector of a null Maxwell field in a space-time with metric g_{ab}^0, then it is also the propagation vector in the space-time $g_{ab} = g_{ab}^0 + 2fl_a^0 l_b^0$. This result, together with the Robinson metric for vacuum gravitational fields and Hughston's generalization to radiating fields, is used to set up equations for combined gravitational and electromagnetic null-fields with special reference to fields with nonzero twist. (auth)

7250 PETROV CLASSIFICATION OF GRAVITATIONAL FIELDS. Hall, G. S. (Univ. of Newcastle-Upon-Tyne, Eng.). J. Phys., A (London); 6: No. 5, 619-623(May 1973).

An intuitive directional symmetry for a null direction with respect to a given local Lorentz observer is suggested. It is shown that the existence of a null direction with such a symmetry with respect to the given Lorentz observer implies that the null direction is a Debever-Penrose direction. A weak converse is also given. In the vacuum case it is shown that the existence of such a null direction is equivalent to the space-time being algebraically special in the Petrov classification and having that null direction as a repeated principal null direction. The results are generalized to nonvacuum space-times. Finally it is suggested how a vacuum space-time might be classified according to the type of symmetries it possesses. (auth)

7251 FORCE ON A PRESTRESSED BODY IN A CURVED SPACE. Pechlaner, E. (Simon Fraser Univ., Burnaby, B. C.). J. Phys., A (London); 6: No. 5, 624-631(May 1973).

Exploring some aspects of the linearized theory of general relativity, new possibilities for experimental tests are discovered. A new design for a gravitational wave detector is suggested. The starting point of these investigations is a part of Newtonian mechanics whose study helps to understand some of the puzzling features of general relativity. The approximations made are as numerous and as severe as in most similar investigations. (auth)

7252 POSITIVITY CONDITIONS IN GENERAL RELATIVITY. Goldberg, J. N.; Klotz, F. S. (Univ. of Syracuse, NY). Int. J. Theor. Phys.; 7: No. 1-2, 31-38(Feb 1973).

The usual treatment of constraints in the canonical formalism is extended to cases where the restrictions on the canonical variables take the form of inequalities. The result is a general prescription for eliminating such restrictions from the canonical formalism. This prescription is applied to eliminate the positivity conditions in a model theory and in general relativity. In the case of the model it is found that elimination of the positivity conditions makes the construction of observables much simpler; in the full theory, however, the spatial constraints introduce complications, and all the calculations have not been carried out explicitly. (auth)

7253 VARIATIONAL PRINCIPLES IN GENERAL RELATIVITY. Taub, A. H. pp 205-300 of Relativistic Fluid Dynamics. Rome; Edizioni Cremonese (1971).

From symposium on relativistic fluid dynamics; Bressanone, Italy (7 Jun 1970). See CONF-700677-.

The Einstein field and the equations of motion for uncharged and charged self-gravitating fluids are derived from variational principles. It is shown how singular hyper-surfaces (shock waves) and the equations governing their behavior may be treated by means of these principles. Also it is shown how the second variation problem is related to the discussion of the stability of the solutions of the Einstein field equations. (JFP)

7254 QUANTIZATION OF WAVE EQUATIONS FOR ZERO-MASS PARTICLES WITH INVARIANT HELICITIES. Simon, M. T.; Seetharaman, M.; Mathews, P. M. (Univ. of Madras). Nuovo Cim.; 15A: No. 2, 299-304(21 May 1973).

Relativistic wave equations were previously constructed in the standard form $i\partial\psi/\partial t = H\psi$ ($\psi \sim D(0,s) \oplus D(s,0)$) for zero-mass particles with invariant helicities. Outlining the essential steps only, the details of second quantization of these equations are presented. (auth)

7255 MOTION OF PARTICLES IN GENERAL RELATIVITY. Moore, W. E. Clemson, SC; Clemson Univ. (1972). 103p. University Microfilms Order No. 73-11,013.

Thesis (Ph. D.).

The post-geodetic equations of motion are determined for a system of gravitating particles, and it is shown that no radiative effects appear in this order. The result demonstrates that each particle of the system acts as a Schwarzschild source for all the others. A variational principle (Hamilton principle) is established for the motion. The equations of motion that are obtained are Lorentz-invariant. The question of covariance under singular coordinate transformations is confronted and it is found that secular predictions are unaffected by such transformations. The final characterization of motion is given in terms of the regular background field, thereby avoiding completely the difficulty of singularities in the resulting equations of motion. There is no restriction on the particle speed. (Diss. Abstr. Int., B)

7256 METHODS FOR PERTURBATION CALCULATIONS IN GRAVITY. Brown, M. R. (Imperial Coll. of Science and Tech., London). Nucl. Phys.; B56: No. 1, 194-204(1973).

It is shown that gravitation, regarded as a self-interacting, massless spin-2 field theory, gives rise to a calculable perturbation expansion. (auth)

REACTOR TECHNOLOGY AND REGULATION

7257 (RDT-STATUS-3-73) BIMONTHLY STATUS REPORT: RDT STANDARDS. Summary as of March 30, 1973. (Division of Reactor Development and Technology (AEC), Washington, D. C.). 19 Apr 1973. 47p. RSO.

7258 NUCLEAR PROGRESS EXTRAORDINARY. Haunschild, H. H. (Federal Ministry for Education and Science, Bonn). Nucl. Active; 16-21(Jan 1973).

Nuclear research and engineering in the Federal Republic of Germany are reviewed. German research programs are devoted to the utilization of nuclear power and the application of radioactive isotopes in industry, agriculture, and medicine. Programs and accomplishments in light water, heavy water, high temperature, ship-propulsion and fast-breeder reactors are described. (FS)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 5321, 5546, 5655, 7424, 7425, 7429, 7518, 7522, 7528–7530, 7534, 7536, 7537, 7539, 7540, 7542, 7547, 7555, 7556, 7569, 7570, 7575, 7584, 7585, 7587–7589, 7592, 7593, 7595, 7600–7605, 7608, and 7611.

7259 (GU–5292) MECHANICAL DESIGN OF THE DRESDEN 1 MIXED-OXIDE DEMONSTRATION ASSEMBLIES. LaBar, M. P. (Gulf United Nuclear Fuels Corp., Elmsford, N. Y.). Mar 1973. Contract AT(11-1)-2210. 68p. Dep. NTIS $5.50.

Mechanical design characteristics of plutonium recycle fuel assemblies for Dresden 1 reactor are described. The eleven Pu bearing assemplies are compatible in dimensions and performance with the Dresden 1 Batch 7 reload fuel assemblies and consist of three normal plutonium assemblies, six "low gadolinium" plutonium assemblies, and two instrumented plutonium assemblies. Descriptions, parameters, and specifications are provided. (FS)

7260 (GU–5295) PRELIMINARY REPORT ON LIGHT WATER REACTOR DECOMMISSIONING COSTS. (Gulf United Nuclear Fuels Corp., Elmsford, N. Y.). Jan 1973. Contract AT(11-1)-1756. 69p. Dep. NTIS $5.50.

Cost estimates are provided for decommissioning an 1100 MW(e) PWR and an 1100 MW(e) BWR. For both reactor types, complete removal and in-place entombment were considered. A list of activities required for each reactor type and decommissioning mode was prepared and the cost of each activity was estimated based on costs incurred during decommissioning of Bonus and Elk River Reactors. Bonus, a BWR, was decommissioned using an entombment concept. Elk River is being decommissioned by completely removing the reactor from the site. (auth)

7261 (TID-26317) GARIGLIANO NUCLEAR POWER PLANT. Annual Report, 1971. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). Jun 1972. 103p. Dep. NTIS $7.25.

Activities at the Garigliano Nuclear Power Plant during 1971 are described. Chapters are included on plant operation, core operation, plant chemistry, and radiological aspects. (JWR)

7262 DECONTAMINATION OF PLUTONIA-CONTAMINATED THERMAL REACTOR SYSTEMS. Divine, J. R. (Battelle-Northwest, Richland, WA). Nucl. Technol.; 18: No. 2, 171-176(May 1973).

In the next five to ten years, the use of plutonium-enriched fuels is expected to increase significantly. As is the case with irradiated uranium-only fuels, radiation levels within the reactor system can be expected to increase in the event of a severe fuel failure. The in-reactor dissolution of mixed-oxide UO_2-PuO_2 fuels has been reviewed with consideration of past experience and potentially useful decontamination solutions. The currently most suitable decontamination agent of mixed oxides is a solution of buffered oxalic acid/hydrogen peroxide/gluconic acid (OPG). (auth)

7263 REVIEW OF THE SITUATION IN BURN-UP PHYSICS: AS SEEN FROM DENMARK. Micheelsen, B. (Atomic Energy Research Establishment, Risoe, Denmark). pp 23-37 of Reactor Burn-up Physics. Vienna; International Atomic Energy Agency (1973).

From IAEA panel on reactor burn-up physics; Vienna, Austria (12 Jul 1971). See STI/PUB-336; CONF-710724-.

The burn-up calculations start with multi-group transport calculations for a fuel rod cell. The cross-section basis is a multi-group library generated from internationally up-dated detailed data, but the data for some of the hundreds of fission products are generated from very crude data. The resonance data can be treated in great detail in sophisticated calculations. The averaged fuel-rod data are used in mathematical procedures for two-dimensional diffusion theory difference-equation multi-group global flux calculations. Coupling of fuel rod or fuel box data to a fast, three-dimensional synthesis flux calculation is being done. In this production and use of the rod-cell data for the global calculation a number of approximations are made, which are quite crude (compared with the calculation modules), and these approximations are discussed. Some parts of the calculation system have been checked against reactor measurements (PWR), but the lack of fuel and representative measurements on modern power-reactor types (LWR) seems to be the outstanding problem of burn-up physics. (auth)

7264 LATTICE BURN-UP CALCULATIONS FOR THERMAL REACTORS. Crowther, R. L. (General Electric Co., San Jose, CA). pp 79-94 of Reactor Burn-Up Physics. Vienna; International Atomic Energy Agency (1973).

From IAEA panel on reactor burn-up physics; Vienna, Austria (12 Jul 1971). See STI/PUB-336; CONF-710724-.

Lattice burn-up calculations in thermal reactors are complicated by the necessity for use of transport theory to represent fuel rods, control rods, and burnable absorbers, by many time-dependent variables which must be considered in the analyses, and by geometric complexity which introduces time-dependent, spatial-spectral variations. Representation of lattice fine structure in a large core is complicated by fuel loading patterns which are non-symmetric. In the USA, these problems are solved by use of both parametric separable cell calculations followed by global analyses to describe spatial interaction of the cells and by discrete representation of every fuel rod in the global analyses. In the latter case, parametric transport-theory fuel rod calculations are carried out to develop cross-sections for use in the global analyses. In the former case the parametric calculations are carried out for one or more fuel assembly cells containing multiple fuel rods. In most models pseudo-fission product representations have been replaced with detailed individual descriptions of the important nuclides. Use of burnable absorbers has complicated both the physical models and the numerical analyses and has required frequent spatial and spectral re-evaluations as a function of burn-up. Feedback data from operating power reactors are becoming increasingly important in the verification of burn-up physics models. Some of these measurements are complicated by the necessity for minimizing the time required for the collection of data, while also achieving high accuracy. The burn-up physics models in use in the USA and the difference in numerical approximations that are utilized in solution of the burn-up equations are reviewed. (auth)

7265 EXPERIMENTAL DETERMINATION OF THE BURN-UP AND HEAVY ISOTOPE CONTENT OF A FUEL ASSEMBLY FROM THE GARIGLIANO BOILING-WATER REACTOR, AND A COMPARISON OF THE RESULTS WITH THEORETICAL CALCULATIONS. Cricchio, A.; Ariemma, A.; Koch, L.; Paoletti, M.; Zaffiro, B. (EURATOM, Karlsruhe, Ger.). pp 163-169 of Reactor Burn-Up Physics. Vienna; International Atomic Energy Agency (1973). (In French).

From IAEA panel on reactor burn-up physics; Vienna, Austria (12 Jul 1971). See STI/PUB-336; CONF-710724-.

An enriched uranium-oxide fuel assembly that had been irradiated in the Garigliano boiling-water reactor was examined after irradiation in order to determine the burn-up and the uranium and plutonium isotope concentrations. The analyses were aimed at checking the results of theoretical calculations carried out by means of the BURNY and BURSQUID codes developed by the ENEL (National Electric Power Company of Italy), using two and five energy groups, respectively. The burn-up was measured from the cesium-137 and neodymium-148, determined by gamma spectrometry and mass spectrometry, respectively; to determine the heavy isotope concentration use was made of mass spectrometry coupled with isotopic dilution analysis. The consistency of the experimental results was tested by the correlation between different abundance ratios for heavy elements or fission products and the burn-up parameters. Correspondence between the experimental and theoretical results was satisfactory: differences of ±1.5% were observed for burn-up and ±4% for the ^{235}U, ^{239}Pu and ^{240}Pu concentrations. (auth)

7266 USE OF COLLISION PROBABILITY METHODS IN LATTICE CALCULATIONS FOR LIGHT WATER REACTORS. Fayers, F. J.; Halsall, M. J. (Atomic Energy Establishment, Winfrith, Eng.). pp 357-375 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

A modular scheme of computation referred to as LWR-WIMS for performing lattice calculations for current designs of both PWR's and BWR's has been developed. This scheme has paid particular regard to the needs of computing efficiency, with attention to the conflicting requirement of achieving adequate validity in the physical model. Considerable recourse to collision probability methods is made in computing a number of aspects of these problems. Coupled-cell methods are used to derive suitable condensation spectra in all regions of the lattice. Appropriate modifications to the diffusion coefficients used in the two-dimensional diffusion theory solution are made based on simplified collision probability calculations, and the same type of method is used to overcome the heterogeneity associated with a cruciform control rod. The computing speeds and accuracies achieved from various approximations to the transport equation are illustrated by numerical studies on test problems. (14 references) (auth)

7267 EXPERIENCE WITH FLUX SYNTHESIS FOR BURN-UP CALCULATIONS ON LIGHT WATER REACTORS. Larsen, H. (Danish Atomic Energy Commission Research Establishment, Risoe). pp 613-628 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

Detailed calculations on modern light water reactors require a computation of the three-dimensional flux distribution. The most straightforward and reliable method for this purpose is the three-dimensional difference-equation technique, the only drawback of this method being that it consumes too much computing time and core memory. Many approximate methods to the difference equation technique have been developed, and one of these is flux synthesis. The advantage of flux synthesis is its fastness; but perhaps the most important thing is that it does not require nearly as much core memory as does the difference-equation technique. A three-dimensional flux synthesis burn-up program SYNTRON has been developed. SYNTRON uses a variational single-channel flux synthesis technique. Calculations have been performed both with SYNTRON and difference-equation programs in two and three dimensions. A discussion is given about the accuracy of flux synthesis, how to select trial functions (expansion functions) and how often it is necessary to recalculate the trial functions in burnup calculations. In static calculations, variational flux synthesis formalism will give acceptable results if a reasonable set of trial functions is used. The real problem is how to select a set of trial functions which is representative at different burnup stages and different void fractions. These problems are discussed and illustrated by some calculations. A method for regeneration of new trial functions from selected flux shapes from the previous three-dimensional synthesis calculation is suggested. (9 references) (auth)

7268 NUCLEAR POWER STATION TULLNERFELD IN ZWENTENDORF. Nistler, W. (Gemeinschaftskernkraftwerk Tullnerfeld GmbH, Vienna). VGB Kraftwerkstechnik; 53: No. 2, 100-105(1973). (In German).

The first Austrian nuclear power station has been under construction for some time. Following a brief description of the 692 MW(e) nuclear power station, with particular reference to the site, the reactor, the turbogenerator and safety equipment, the licensing procedure is outlined. The titles of some papers which have been published and a progress report on construction to date are given. (GE)

7269 NUCLEAR POWER PLANT SYSTEMS AND EQUIPMENT. Lish, K. C. New York; Industrial Press Inc. (1972). 187p. $17.50.

Hardware and systems needed to assemble a nuclear power plant are discussed. Various systems and equipment required by the BWR and PWR are described including: containment, cooling, residual heat removal, emergency systems, plant ventilation, instrumentation, spent-fuel storage facilities, radioactive-waste handling, and quality assurance. The BWR and PWR are graphically analyzed, and the HTGR is generically described. The appendixes include: General Design Criteria for construction permits, Quality Assurance Criteria, Codes and Standards, and a listing of areas requiring Inservice Inspection in Coolant Systems. (FS)

7270 GAMMA SPECTROMETRY AT A NUCLEAR POWER PLANT USING A DIGITAL COMPUTER. Webster, B. H.; Kowalczuk, A. D. (Carolina Power and Light Co., Raleigh, NC). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 767-773(Feb 1973).

A gamma spectrometer system with sodium iodide and germaniumlithium drifted detectors and digital minicomputer was selected for use at the Brunswick Steam Electric Plant. The equipment selection was based on the effluent reporting requirements of AEC Safety Guide 21—measuring and reporting of effluents from nuclear power plants. General software routines were not available for this specific application. A functional description of the software has been defined and the specific routines are in development. These routines automate radionuclide analysis and report generation for the nuclear power plant technician. The operating objective of the gamma spectrometer system is to routinely provide a detailed radionuclide analysis of samples, using a minimum of wet chemistry, to meet the requirements of plant Technical Specifications while operated by the plants' Radiation Control and Test Technicians. Changes in in-plant and effluent analysis requirements during the past two years have made existing equipment of that time inadequate for the needs of today and the future. The minicomputer based gamma spectrometer system provides the maximum amount of flexibility available today to meet tomorrow's demands. (4 references) (auth)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 5321, 5655, 7260, 7262, 7263, 7266, 7267, 7378, 7419, 7420, 7425, 7517, 7531–7535, 7538, 7541, 7543–7546, 7548–7554, 7557–7568, 7571–7574, 7576–7583, 7586, 7590, 7591, 7594, 7596–7599, 7606, and 7607.

7271 (BAW-10039) PROTOTYPE VIBRATION MEASUREMENT RESULTS FOR B AND W's 177-FUEL-ASSEMBLY, TWO-LOOP PLANT. Thoren, D. E.; Fortune, H. J. (Babcock and Wilcox Co., Lynchburg, VA (USA). Nuclear Power Generation Div.). Apr 1973. 45p.

The results of a prototype vibration measurement program conducted at the Oconee Nuclear Station, Unit 1 are presented. The use of Unit 1 internals as the prototype reactor internals for B&W's 177-fuel-assembly, two-loop line of reactors is justified. (auth)

7272 (DLCS-5000472) SHIPPINGPORT ATOMIC POWER STATION. Quarterly Operating Report, Fourth Quarter 1972. (Duquesne Light Co., Shippingport, PA). 1972. Contract AT (11-1)-292. 24p. Dep. NTIS $3.25.

During the fourth quarter of 1972, the Shippingport Atomic Power Station was operated as required for Duquesne Light Company system load demand, testing, and maintenance. There were no forced outages and the Heat Dissipation System remained shutdown during this period. The cold plant station shutdown continued for testing, training, and maintenance. On October 13, 1972 the ac core removal cooling was removed from service and plant pressurization and heat-up commenced. During the shutdown, the 1A Loop was returned to service following steam generator repairs. A weld leak developed on the loop outlet manual valve bonnet leak off line. The plant was cooled down and necessary repairs performed. A plant heat-up was again performed and the station returned to power operation. Upon return to power with 4 loop operation, it was established that a minor leak existed in the steam generator. This leak was not detected during the leak test performed before returning the steam generator to service. The leak has remained essentially constant at approximately 1.5 gph. Also during the shutdown "Loss of ac power drills" were conducted and the "Minor Release of Atmosphere" of the Emergency Plan was performed. A station shutdown and start-up was performed for maintenance repairs on river water screens and steam system valves. One operational incident occurred during the report period which involved momentary overpressurization of the purification loop system due to a valving error. Back-up relief valve operation provided equipment protection and the system was returned to normal service. During the period two offsite shipments of solid radioactive waste were made. Total shipments contained 320 drums of waste, weighing 64,057 pounds and contained 458.9 millicuries of activity. (auth)

7273 (WCAP-7160(Vol.2)) ECONOMIC UTILIZATION OF PLUTONIUM IN PRESSURIZED WATER REACTORS. Volume 2. Final Report. (Westinghouse Electric Corp., Pittsburgh, Pa. Nuclear Fuel Div.). Feb 1968. 242p.

Sections are included on nuclear parameter studies, fuel engineering studies, fuel cycle studies, physics methods development, and nuclear design studies. (JWR)

7274 BURN-UP PREDICTION FOR PRESSURIZED WATER-REACTOR CORES. Moncassoli-Tosi, A. M. (FIAT, Turin). pp 1-22 of Reactor Burn-Up Physics. Vienna; International Atomic Energy Agency (1973).

From IAEA panel on reactor burn-up physics; Vienna, Austria (12 Jul 1971). See STI/PUB-336; CONF-710724)-.

The Italian current state-of-the-art in burn-up prediction for pressurized water reactors (PWR) is presented. The computing methods and the experiments analyzed to assess their validity are reviewed. The predictions are made with well-known nuclear design methods using up-to-date basic data ensuring reliable results for PWR of a proven type. The experiments analyzed refer mainly to critical and subcritical measurements on a lattice designed for a PWR for ship propulsion and to the operating and post-irradiation data obtained from the Trino-Vercellese power plant. The precisions achieved are discussed in detail and some recommendations concerning improvements in theory and basic data are stated. (auth)

7275 PHYSICAL CHARACTERISTICS AND FUEL BURN-UP OF WATER-MODERATED WATER-COOLED POWER REACTORS. Kamyshan, A. N.; Novikov, A. N. (Inst. of Atomic Energy, Moscow). pp 125-137 of Reactor Burn-Up Physics. Vienna; International Atomic Energy Agency (1973). (In Russian).

From IAEA panel on reactor burn-up physics; Vienna, Austria (12 Jul 1971). See STI/PUB-336; CONF-710724-.

Methods and results of theoretical and experimental research on physical characteristics and fuel burn-up of the Water-Moderated Water-Cooled Power Reactor-3 of the second unit of the Novo-Voronezh Nuclear Power Plant are presented. (auth)

7276 POST-IRRADIATION BURN-UP ANALYSIS OF TRINO VERCELLESE REACTOR FUEL ELEMENTS. Comparison With Theoretical Results. Moncassoli-Tosi, A. M. (FIAT, Turin); Rama, P. G.; Bresesti, A. M.; Bresesti, M.; Facchetti, S.; Klersy, R.; Mannone, F.; Schueremkaemper, A.; Cricchio, A.; Koch, L. pp 197-225 of Reactor Burn-Up Physics. Vienna; International Atomic Energy Agency (1973).

From IAEA panel on reactor burn-up physics; Vienna, Austria (12 Jul 1971). See STI/PUB-336; CONF-710724-.

The post-irradiation analyses carried out on the Trino-Vercellese spent fuel are presented in detail. The majority of the measurements has been performed at Ispra CCR-Laboratory but a sample has also been measured at Karlsruhe CCR-Laboratory for the purpose of testing the consistency of the results. The burn-up values inferred from different measured data are compared with the theoretical predictions obtained by using a detailed evaluation method. The conclusions show a 3% accuracy in the assembly-wise burn-up predictions and a 5% accuracy in the local burn-up estimates. (auth)

7277 SPECIAL FUEL AND ABSORBER MANAGEMENT PROBLEMS OF LIGHT-WATER REACTORS AND THEIR SOLUTION WITH IMPROVED CALCULATIONAL METHODS. Maerkl, H.; Mueller, A.; Wagner, M. R. (Siemens, AG, Erlangen, Ger.). pp 255-275 of Reactor Burn-Up Physics. Vienna; International Atomic Energy Agency (1973).

From IAEA panel on reactor burn-up physics; Vienna, Austria (12 Jul 1971). See STI/PUB-336; CONF-710724-.

Fuel and absorber management problems play an increasingly important role in power-reactor operating characteristics during the lifetime of a reactor. Proper absorber management procedures must be applied in order to meet the increasing need for load-following flexibility and for the capability of extending or shortening the length of burn-up cycles for economic or practical reasons. Pressurized water reactors prove to be very well suited to meet these requirements. The control philosophy developed for Siemens PWRs is described in some detail. To exploit further the core performance potential of PWRs, three-dimensional depletion calculations are mandatory. Recently, efforts have been made to develop a sufficiently accurate fast running 3D burn-up code MEDIUM based on a new nodal method in which the spatial coupling is given by collision probabilities and which has a much better theoretical background than the conventional nodal techniques. In this development, maximum use has been made of efficient convergence acceleration procedures which lead to quite acceptable running times even for large loosely coupled reactors. (auth)

7278 NUCLEAR REACTOR ANALOG SIMULATION FOR UNDERGRADUATE NUCLEAR ENGINEERING EDUCATION. Fenech, H.; Bayne, J. (Univ. of California, Santa Barbara). Simulation; 20: No. 4, 127-135(Apr 1973).

The theory and design of an analog nuclear reactor simulator for undergraduate nuclear engineering education is presented. The simulator mimics the behavior of a 1000-MW(e) pressurized water reactor and its thermal-to-electrical energy conversion plant. In addition, several model parameters may be hand-selected, allowing for variations in dynamics and power levels and for accidents. Actual simulator results are presented and discussed. (auth)

7279 REACTEURS NUCLEAIRES A EAU PRESSURISEE. Theorie, Technologie et Applications a la Propulsion Navale. (Pressurized Water Reactors. Theory, Technology, and Application to Naval Propulsion). De Ladonchamps, J.; Verdeau, J. J. Collection de l'Ecole Nationale Superieure de Techniques Avancees. Paris; Masson et Cie (1972). 235p. 95 F.

Basic data for the design, calculation, and construction of pressurized water reactors are compiled. The classic theories from which very complex numerical calculation codes have been developed are first reported. The specific characteristics of pressurized water reactors with respect to design and performance are presented. Nuclear propelled ships are then described. The problems caused by the installation of reactors on board ship and the economic prospects opened to maritime transport are both considered. (JSR)

7280 DIGITAL SIMULATION OF THE CALVERT CLIFFS NUCLEAR POWER PLANT. McNally, J. K. (Combustion Engineering, Windsor, CT); Chen, W. L. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 774-779(Feb 1973).

Combustion Engineering recently completed installation of a pressurized water reactor simulator at its Windsor, Connecticut engineering facility. This simulator duplicates the control room of Baltimore Gas & Electric Company's Calvert Cliffs Unit #1. Principal characteristics of the plant are given. The simulator was designed and constructed by Singer Company, Simulation Products Division. (auth)

7281 PRESENT STATUS OF THE USE OF ACOUSTICAL AND OPTICAL METHOD FOR THE DETECTION OF BOILING IN NUCLEAR REACTORS. Bonnet, J. A. Jr. Energ. Nucl. (Madrid); 16: No. 80, 637-643(1972). (In Spanish).

Various methods of detecting boiling in water-cooled and sodium-cooled reactors are discussed. Of the methods discussed those receiving the most study are ultrasonics, neutron fluctuations, and detection of acoustical noise. Proposed methods discussed include measurement of the temperature within the core, measurement of vibrations, attenuation of sound waves, changes in neutron density with sound waves, and acoustical methods. Before any of these methods can be used in a reactor, an extensive analytical and experimental program is necessary. (tr-auth)

7282 725-MVA UNIT-CONNECTED TRANSFORMERS FOR THE BIBLIS NUCLEAR POWER STATION. Dietrich, W.; Seiterle, W. (Transformatoren Union AG, Stuttgart). Elektrizitaetswirtschaft; 72: No. 8, 202-205(1973). (In German).

The 725 MVA generator transformers supplied for the Biblis nuclear power station belonging to the Rheinisch-Westfaelisches Elektrizitaetswerk AG are at present the largest units in the German Federal Republic. A description is given of the arrangement and construction of the two transformers manufactured by the Transformatoren Union AG. A single concentric winding arrangement was adopted, as it proved to be most efficient. For adjustment of the transformer ratio under a load of 2,000 A, neutral-point step switches are provided. Heat is dissipated by an existing oil-water cooling installation comprised of 6 groups. A measurement was made at full current as a type test in addition to the standard tests. (GE)

7283 MANIPULATION OF A HEAVY LID. (to Electricite de France). French Patent 2,115,001. 7 Jul 1972. Filed date 20 Nov 1970. 11p. (In French).

A process for manipulating the heavy lid of a vessel containing radioactive products (in particular the prestressed concrete lid of the vessel of a pressurized light water reactor) is described. A pool surrounding the lid is progressively filled with a liquid providing protection against the radiation. This pool is sufficiently large to permit the manipulation of the lid. A fluid having a lower density than that of the liquid is introduced or maintained in an enclosure fixed to the lid. This enclosure contains a sufficient quantity of fluid to give the lid an effective density similar to that of the liquid. (FR)

7284 EFFECT OF IRREGULARITIES IN THE OPERATION OF NUCLEAR REACTORS ON FUEL CONSUMPTION. Meyer, K. (Technical Coll., Zittau, Czech.). Jad. Energ.; 19: No. 4, 109-111(Apr 1973).

The effect of deviations during the campaign of a pressurized water reactor on fuel consumption with respect to power produced was investigated on the basis of a statistical model. In addition, the magnitude of losses was estimated which are due to the fact that the actual campaign is generally shorter than its predetermined length. It appears that the effect of the two loss sources is of an order of magnitude which corresponds to the order of magnitude of the gain which may be attained by the load reduction at the campaign end. (auth)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstract 7269.

7285 (CEA-CONF-2214) CALCULATION OF THE CIRCUITS ACTIVITY IN A HIGH TEMPERATURE REACTOR. Brisbois, J.; Beslu, P.; L'homme, A. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 31p. (In French). Dep. NTIS (U. S. Sales Only) $3.75.

In a HTR reactor, the activity in the circuits, particularly the heat exchanger, comes mainly from metallic fission products escaped from the fuel. Such a fuel is made from oxide particles coated with PyC and SiC, but part of the fuel has a defective coating (due to fabrication hazards or irradiation damage). The fission product activity in the circuits may be calculated from the number of failed particles. The calculations are divided in two steps: migration of the fission products through graphite parts of the fuel and migration of the fission products in the circuit. For both these steps, a model has been developed from the study of the physical phenomena concerned. An example is given of an application to a 3000 MW(t) reactor. (tr-auth)

7286 (CONF-730507-1) RESIN FUEL PARTICLES FOR HIGH TEMPERATURE GAS-COOLED REACTORS. Silverman, M. D.; Pollock, C. B. (Oak Ridge National Lab., Tenn.). 1972. 4p. Dep. NTIS $3.00.

From American Chemical Society; Detroit, Michigan, USA (1 May 1973).

Fuel particles for HTGR reactors were prepared from weak-acid exchange resins. Loading with uranium is accomplished by using UO_3 in slurry form and heavy metal loading ensures stability of the microspheres during subsequent carbonization and heat treatment, which is performed under an inert gas in a fluidized bed. Water is removed endothermally between 100 and 200°C, and breakup of the polymer occurs in the 300 to 350°C range. Carbonization along with decarboxylation takes place exothermally from 350 to 450°C, with appreciable formation of carbon monoxide and carbon dioxide. Carbonization is largely completed by 600°C, with minor loss of hydrogen and CO on additional heating to 1000°C yielding spheres of approximate overall composition $UO_{2+x} + 5C$. Heat treatment above 1200°C is used to remove oxygen and gradually convert the fuel phase from UO_2 to UC_2. The ratio of oxide to carbide and the amount of excess carbon in the kernels can be adjusted by varying the time and temperature of the heat treatment. The major advantages of the resin-prepared kernels are (1) inexpensive raw materials available from several sources, (2) excellent control of sphere size, shape, and quality established before fuel loading, (3) good reproducibility of heavy metal loading, (4) relatively easy remote loading of ^{233}U, (5) reduced importance of variations in buffer coating thickness, and (6) potential improved resistance to thermal gradient-induced kernel migration. (auth)

7287 (DP-Report-614) OPERATIONAL DATA FOR CHARGE II. Dragon Project. Hunt, C.; Poston, L. J. (Atomic Energy Establishment, Winfrith (England)). Feb 1969. 31p. Dep. NTIS (U. S. Sales Only) $3.75.

A general survey of the important operational events is given together with tables and figures summarizing the irradiation history. A complete list of the representative data logs is provided and the processed data and associated library are available on KDF-9 computer magnetic tapes. The minor program changes introduced for Charge II are described and in the present state no further additions can be made without overflowing the capacity of the KDF-9 computer. This is being overcome by reorganizing the program into several chains. Work on these lines has started for the Charge III program where substantial changes are required. For future Dragon cores, allowance must be made for different irradiation times for the center and outer rods so that effectively 74 fuel "elements" must be considered. The introduction of U 238 in large quantities and the subsequent breeding of plutonium isotopes require major extensions of the FIDO subroutine. All these changes will be available for Charge III assessment. The present data handling system does not include information on fission product release or coolant chemistry. (auth)

7288 (DP-Report-622) HELIUM COOLANT CHEMISTRY AND THE BASIC DESIGN OF A MOLECULAR SIEVE H_2O AND CO_2 ADSORPTION PLANT FOR LOW INLET PARTIAL PRESSURES USING DRAGON PROJECT AND OTHER PUBLISHED EXPERIMENTAL DATA FOR THE COARSE PURIFICATION OF THE HELIUM COOLANT USED IN A 1,500 MW(th) HIGH TEMPERATURE GAS-COOLED POWER REACTOR. Dragon Project. Harper, C.; Kinsey, D. V. (Atomic Energy Establishment, Winfrith (England)). Mar 1969. 63p. Dep. NTIS (U. S. Sales Only) $5.25.

7289 (DP-Report-667) ECONOMICS OF THE FIRST GENERATION HIGH TEMPERATURE REACTORS AND FUTURE PROSPECTS. Dragon Project. Gutmann, H.; Daub, J.; Schober, H.; Graziani, G.; Zanantoni, C. (Atomic Energy Establishment, Winfrith (England)). Oct 1969. 17p. (CONF-691020-4). Dep. NTIS (U. S. Sales Only) $3.00.

From symposium on nuclear energy costs and economic development; Istanbul, Turkey (20 Oct 1969).

A survey on the economics of the currently designed high temperature gas cooled reactors is presented. The survey is limited to high temperature reactors using prismatic fuel elements. Future prospects in high temperature reactor development are briefly discussed. (JWR)

7290 (DP-Report-673) DRAGON PROJECT PROGRAMME OF CORE MATERIALS DEVELOPMENT FOR HIGH TEMPERATURE POWER REACTORS. Dragon Project. Huddle, R.A.U. (Atomic Energy Establishment, Winfrith (England)). Oct 1969. 17p. (CONF-691140-4). Dep. NTIS (U. S. Sales Only) $3.00.

From fuel symposium; Bournemouth, UK (4 Nov 1969).

The development of fuels, moderators, and core structural materials in the Dragon project is summarized. This development included design, fabrication, and performance testing of coated particles, the fuel body, fuel rods, and structural moderator blocks. (JWR)

7291 (DP-Report-690) INFLUENCE OF FUEL AND FUEL ELEMENT ON POWER REACTOR GENERATING COSTS. Dragon Project. Gutmann, H.; Daub, J.; Mancini, G.; Schober, H. R.; Graziani, G. (Atomic Energy Establishment, Winfrith (England)). Jan 1971. 33p. (CONF-691140-2). Dep. NTIS (U. S. Sales Only) $3.75.

From fuel symposium; Bournemouth, UK (4 Nov 1969).

An optimization of Dragon-type high temperature reactors with respect to fuel requirements and fuel element design is attempted. The survey philosophy and cost assumptions used are discussed. Prospects for a tubular interacting design are briefly examined. (JWR)

7292 (DUN-8028-B) FINAL REPORT PRODUCTION TEST NO. Pt N-318 AND TEST CHANGE NO. 1 PRESSURIZER LEVEL AND INJECTION WATER FLOW CONTROL TEST. Flickinger, J. K. (Douglas United Nuclear, Inc., Richland, Wash.). 6 Mar 1973. 12p. Dep. NTIS $3.00.

The NPR Reactor pressurizer control system performance was improved in stability for both shutdown and operating test transients. For a change of 200 gpm in spill flow, the maximum dip in pressurizer level was 5" during either shutdown or operating conditions. For a change from 1100 gpm to 1625 gpm, with the reactor operating at 500 MW, the pressurizer level decreased only 6" total. This decrease in level, or offset, was expected due to the elimination of Reset action on the controller, however, this small offset is considered an acceptable trade-off to obtain stable level control. The instability and cycling previously experienced on makeup flow control was eliminated. Satisfactory automatic control was demonstrated through several operating and shutdown periods. Some instability of the Pump Suction differential pressure is still evident as loop pressure increases from 900 to 1300 psig. This problem has always been experienced and results from the interaction of several control loops at this stage of each startup. (auth)

7293 (DUN-8043) STATUS OF THE 117-N CHARCOAL FILTERS, JUNE 1972. Bennett, E. C.; Strege, D. E. (Douglas United Nuclear, Inc., Richland, Wash.). 23 Aug 1972. Contract AT(45-0)-1857. 11p. Dep. NTIS $3.00.

The inplace testing on the NPR Reactor filter beds, plus laboratory tests on charcoal samples from the filters, has shown that all filters are well above the minimum halogen retention efficiency of 95.0 percent (96% EMS replacement requirement). Loading tests show that only minor degradation of the charcoal beds has occurred during the two years they have been in service, and they should retain adequate elemental halogen retention capability throughout the projected three-year operating period. The next set of charcoal tests will permit an extrapolation of filter efficiency decay to better assess filter life. (auth)

7294 (DUN-8131) N REACTOR PIPING DECONTAMINATION, 1973. Ferguson, D. B.; Frymier, J. W.; Lorenzen, J. L. (Douglas United Nuclear, Inc., Richland, Wash.). 27 Feb 1973. 85p. Dep. NTIS $6.25.

To remove activation products (fission and corrosion) from the inside surfaces of the N Reactor primary front and rear piping to significantly reduce existing radiation levels in these areas, Turco 4512-A will be injected at a controlled variable rate into a variable flow stream of heated demineralized water, and will be applied once-through the emergency raw water dump system. The chemical effluent will be directed to the chemical waste tank for storage and subsequent disposal. The primary piping on front and rear faces in the 105-N Bldg will be cleaned by applying a single-pass, 8% by volume, solution of Turco 4512-A, at 170°F to 175°F, for approximately 25 minutes. (auth)

7295 (GULF-GA-A-12515) HTGR BASE PROGRAM QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING FEBRUARY 28, 1973. (Gulf General Atomic Co., San Diego, Calif.). 30 Mar 1973. Contract AT(04-3)-167. 108p. Dep. NTIS $7.50.

The High-Temperature Gas-cooled Reactor (HTGR) work reported includes studies of basic fission-product distribution mechanisms, recycle fuel studies (including designing and testing of recycle test elements) and exploration of head-end reprocessing methods (as part of a national recycle plan and of a recycle fuel plan), and physics and fuel management studies. Materials studies include irradiation and analysis of fuel particles in capsules to evaluate fuel systems, and basic studies of control materials and of carbon and graphite. Experimental procedures and results are discussed and, where appropriate, the data are presented. (auth)

7296 (JUL-920-RG) COST ANALYSIS OF COMPONENTS FOR NUCLEAR POWER PLANTS WITH HIGH-TEMPERATURE REACTOR AND GAS-TURBINE. Schlenker, H. V. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Feb 1973. 157p. (In German). Dep. NTIS (U. S. Sales Only) $10.00.

A cost analysis investigated the influences of parameters for components of a power station with a helium-cooled high-temperature reactor and with a helium turbine. The selected components are: the recuperative heat-exchanger, the pre- and intermediate cooler, the cooling tower, the prestressed concrete pressure-vessel, the turboset, and a section of the helium ducts. The cost analysis, absolute costs are avoided and substituted by relative costs. Reference for each component is a well specified base case, the costs of which are estimated in detail. The costing model subdivides the costs of a component two times: the first into physical parts and then into material costs and manufacturing costs. By relating the subdivided costs to the total costs of the component in the base case, the relative cost changes can be led back to constants, indicating the fractions of the subdivided costs on the total costs in the base case, multiplied with cost functions representing the relative cost changes of the subdivided costs for the case with changed parameters. These cost functions consisting of a base function and a multiplicative correction term allow for consideration not only of general tendencies but also of individual conditions. The results of the cost analysis are presented under four sections: analysis, design, costing, and results. In the first two sections the component is generally described and the main data and the conditions retained. This includes the assumptions for the design and the calculation of the component. In the third section the subdividing of the costs, the constant cost fractions, and the cost functions are treated. The relative cost changes are presented in the last section. The influences of the main parameters on the costs are given by means of functions which are obtained by approximating the curves with the statement: $a + x^n$ (x = parameter). The cost analysis is explained in a flow diagram. The formulas for the costing model are deduced. The advantages of the model are shown by comparison with other methods. Computer programs are established for the execution of the cost analysis. For some of the components sensitivity analyses are performed for the comprehension of the accuracy of the results. (auth)

7297 (RD/B/N-2473) EXAMINATION OF BURNABLE POISON DEPLETION IN WAGR. Beynon, A. J.; Gavan, T. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs). Nov 1972. 31p. Dep. NTIS (U. S. Sales Only) $3.75.

Two stringers of WAGR fuel with prototype burnable poison elements were irradiated to poison burnups from ~10 to 95%, to test the physics predictions of burnup behavior, and to demonstrate that the mechanical and materials aspects of poison design were satisfactory. Two methods were used to measure the quantity of poison remaining. For the first stringer, poisons were diluted so the effective unself-shielded cross section could be compared with that of natural gadolinium in a reactor measurement. For the second, mass spectroscopy was used to measure the depletion of high cross section isotopes, giving a more direct comparison. The theoretical analysis used the calculational route recommended for CAGR poison design, i.e. fine structure was calculated by the PRIZE code, poison burnout by the DECYGAD code, and composite poisoned fuel burnout by the ARGOSY code. DECYGAD option allowed isotropic or forward peaking fluxes to be considered. (auth)

7298 SYNTHETIC NATURAL GAS AS A NUCLEAR ENERGY CARRIER OVER LONG DISTANCES. Schulten, R. (Kernforschungsanlage, Juelich, Ger.). Umsch. Wiss. Tech.; 73: No. 2, 53-54(1973). (In German).

The heat energy production in high temperature reactors can be used to transform fossil fuels into gases. Methane, derived from coal, could serve as an economical energy carrier over long distances satisfying the heat demand of households and factories. Temperature problems are discussed and some methods of methane processing are described. (GE)

7299 BURN-UP PHYSICS FOR THE DRAGON HIGH-TEMPERATURE REACTOR. Hunt, C. (Atomic Energy Establishment, Winfrith, Eng.). pp 39-55 of Reactor Burn-Up Physics. Vienna; International Atomic Energy Agency (1973).

From IAEA panel on reactor burn-up physics; Vienna, Austria (12 Jul 1971). See STI/PUB-336; CONF-710724-.

The main function of the Dragon Reactor Experiment is to irradiate HTR fuels and proposed power reactor "pins" to peak burn-up values of about 100,000 MWd/t. Physics calculations are needed both to design experiments which are required to simulate power reactor operating conditions and to follow the in-core behavior so that accurate burn-up and local rating history data can be made available prior to post-irradiation examination of the experimental fuels. With these very high burn-ups, which are a special feature of particulate fuel in the HTR concept, accurate predictions constitute a formidable task. This task is particularly difficult in the experimental reactor where the fuel compositions vary widely over the core adding to the complexity of the problem. The methods used in predicting and following the operating behavior of the system are described and the main sources of uncertainty identified. A brief description is given of the post-irradiation evaluation of burn-up and a comparison made with the physics calculations. A special series of experiments designed to check the theoretical methods and improve the knowledge of burn-up, isotopic build-up and reactivity evaluation of fission products is referred to. The general conclusion is reached that the main area of uncertainty, for Dragon at least, is the evaluation of the spatial power distribution in the core. (auth)

7300 SEPARATED LOCATION OF THE PARTIALLY DEPLETED FUEL IN THE PEBBLE-BED REACTOR. Maly, V.; Teuchert, E. (Kernforschungsanlage, Juelich, Ger.). pp 57-70 of Reactor Burn-Up Physics. Vienna; International Atomic Energy Agency (1973).

From IAEA panel on reactor burn-up physics; Vienna, Austria (12 Jul 1971). See STI/PUB-336; CONF-710724-.

There is a new operating scheme for the pebble-bed reactor suggested: the "Once Through Then Out (OTTO)". The basic change to the conventional type consists in slowing down the movement of the balls through the core so that they reach the final burn-up in one single run. The consequence is a high axial asymmetry in neutron fluxes, in fuel enrichment, fuel depletion, and in distribution of power density. The space-dependent irradiation history of the fuel elements is followed by the reactor code system V.S.O.P. from the initial loading to the equilibrium cycle. The very strong axial flux tilt causes an extremely varying irradiation history in the balls during the run through the core, and a modified efficiency of the nuclides of fission product chains. The mutual interaction of flux and depletion in the middle of the core area results in a very good accommodation in the final burn-up of the spheres. The highly asymmetric power shape causes a spatially different xenon build-up and a shift in power shape during an override. Choosing a suited axial arrangement of differently enriched fuel in the initial core makes it possible to start the reactor with a power distribution very similar to the equilibrium core. It results in a very short and smooth running-in period, and the change in the power shape is below that of a 100 - 40% xenon override. (auth)

7301 UNITED KINGDOM APPROACH TO THE CALCULATION OF BURN UP IN THERMAL REACTORS. Tyror, J. G.; Askew, J. R. (United Kingdom Atomic Energy Authority, Winfrith, Eng.). pp 95-112 of Reactor Burn-Up Physics. Vienna; International Atomic Energy Agency (1973).

From IAEA panel on reactor burn-up physics; Vienna, Austria (12 Jul 1971). See STI/PUB-336; CONF-710724-.

The facilities available in the WIMS suite of codes for the calculation of depletion in lattice cell geometry are described. This level of representation is the most detailed in its treatment of nuclear data, and represents the "best" United Kingdom calculation which may be used alone or as a basis for adjustment of simpler models. The various levels of representation appropriate to reactor fuel management are discussed, including both explicit and implicit treatments of depletion. It is concluded that different calculational models may be appropriate to different reactor types. The implications of this in the design of computing schemes are indicated by reference to the WIMS-E compatible code scheme. Comparisons between WIMS results and measurements of isotopic changes in fuel irradiated in a range of reactor types demonstrates good agreement. (auth)

7302 ON-LINE DATA ACQUISITION AND PROCESSING SYSTEM FOR THE HTGR. Nowicki, S. J. (Gulf General Atomic Co., San Diego, CA); Hubbard, D. G.; Jones, R. T. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 717-723(Feb 1973).

The standard design for all advanced High-Temperature Gas-Cooled Reactor (HTGR) nuclear power plants includes an integrated instrumentation system using a digital-computer-based Data Acquisition and Processing (DAP) system. This integrated-systems approach to instrumentation and controls improves plant availability and efficiency of operation. The DAP system configuration, system hardware, software, and major functions are described. The man/machine interface during plant operation is described in more detail. (auth)

7303 COMPUTER-CONTROLLED REFUELING MACHINE AT FORT ST. VRAIN. Smith, C. W. (Gulf Energy and Environmental Systems Inc., San Diego, CA); Mathie, F. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 780-785 (Feb 1973).

The refueling system for the Fort St. Vrain Nuclear Generating Station uses a small digital computer for automatic control to handle approximately 3000 fuel and reflector blocks which constitute the reactor core. The computer has complete control of the handling mechanism, which has four freedoms of motion, and also logs information concerning all fuel movements for inventory purposes. Since safety is a prime consideration in equipment associated with a nuclear power plant, a combination of hardware and software protection monitors provides for fail-safe operation. Operating experience has proved that automatic control of the fuel handling process is approximately five times faster than manual operation with the same machine. In addition, operator errors are eliminated and an accurate log of all fuel movements is recorded. (auth)

7304 COMPARISON OF NUCLEAR POWER PLANTS WITH CLOSED CYCLE HELIUM TURBINE AND WITH STEAM TURBINE CYCLE FOR COMBINED POWER AND STEAM GENERATION. Bammert, K. (Univ., Hanover); Buende, R. J. Eng. Power; 95: No. 1, 11-18(Jan 1973).

The heat of a helium-cooled reactor can be used for combined power and steam generation either in a closed-cycle helium turbine system, the so-called single-cycle system, or in a two-cycle system which consists of a helium cycle and a secondary steam turbine cycle. The optimum data for the two systems are determined within the same range of general parameters—electric power output and quantity and quality of the steam produced—as functions of the special parameters of each particular cycle system. A method of comparing different power plant systems is shown. With this method it is possible to determine those ranges in which the efficiencies achieved with one system are higher than those obtained with the other. It is described in which way the dividing line between such ranges depends on the special parameters of the cycles. The comparison shows that the single-cycle system offers advantages. (auth)

7305 UENTROP-SCHMEHAUSEN THTR-300. Casa, A. F.; Sansone, M. M. Com. Naz. Energ. Nucl., Notiz.; 19: No. 1, 45-56(Jan 1973). (In Italian).

The history and main specifications of the German plant and THTR 300 reactor, the construction of which was recently started at Uentrop-Schmehausen are discussed. A description and methods for production of its fuel elements are given. (auth)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 5435, 5643, 7516, and 7519.

7306 (AAEC/TM-630) EXAMINATION OF DESIGN METHODS FOR CALCULATING POWER DISTRIBUTIONS IN BATCH FUELLED REACTORS. Hesse, E. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug 1972. 28p. Dep. NTIS (U. S. Sales Only) $3.50.

Comparisons are made between design methods of calculating power distributions in batch fuelled reactors. Core power distributions obtained using explicit representation for each channel with a single mesh point per channel are subject to large errors. Accurate estimates can be made by increasing the number of mesh points but, for large power reactor cores, this may be beyond the available computing capacity. The alternative EQUICORE method, based on an RZ macroscopic flux and a superimposed supercell calculation, gives sufficient accuracy for design calculations of large power reactors, with considerable savings in computing time. (auth)

7307 (AECL-4356) PRESENT STATUS AND FUTURE DEVELOPMENT OF HEAVY-WATER REACTORS IN CANADA. Gray, J. L.; MacKay, I. N. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Jan 1973. 11p. (CONF-721222-1). Dep. NTIS (U. S. Sales Only) $3.00. AECL $0.50.

Ten years ago the first Canadian-designed nuclear power plant, generating 22 MW(e), commenced operation. There are now 15 units, totalling some 6800 MW(e), operating or under construction, with more planned. The performance of the first three fully commercial units at Pickering has been exceptionally good. A severe heavy-water shortage, caused by failure to operate the first plant, should end by about 1974. One new plant is in production and a third, of double the capacity, is in the commissioning stage. The increasing cost of new hydro development and of fossil fuels requires a rapid increase in nuclear power development in most parts of Canada. Development work intended to reduce the cost of power from reactors moderated and cooled by heavy water, without sacrificing reliability, is being actively pursued. Much of this can be applied to existing reactors, principally to reduce fuel cycle costs. Two new cooling systems are being investigated. The boiling light-water system is in operation in the 250 MW(e) plant at Gentilly, Quebec, and a preliminary design for an organic-cooled prototype is being prepared. At this stage each system appears to have unique advantages. Improved methods of producing heavy water are also under development. (auth)

7308 (ZJE-120) ACCIDENT AND SAFETY ANALYSIS OF THE KS 150 REACTOR. Hulovec, J. (Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Construction Dept). 1972. 171p. Dep. NTIS (U. S. Sales Only) $10.75.

The state-of-art and the development trends of power reactor safety are briefly reviewed. The KS-150 reactor safety analysis is examined. A method of reactor safety evaluation based on the postulate of extreme initiating events is proposed and applied. Different accident states are analyzed in detail and the probability of their occurrence during the reactor lifetime is estimated. The analysis of accident states is made using the original mathematical models of the A-1 nuclear power station and its primary circuit. These models are programmed for numerical and analog computers available in Czechoslovakia. The results obtained may be used in the elaboration of the A-1 nuclear power station operation guidelines. (auth)

7309 ADVANCES IN LOCAL NUCLEAR-FUEL BURN-UP PHYSICS. Pop-Jordanov, J. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 71-77 of Reactor Burn-Up Physics. Vienna; International Atomic Energy Agency (1973).

From IAEA panel on reactor burn-up physics; Vienna, Austria (12 Jul 1971). See STI/PUB-336; CONF-710724-.

The advances in theoretical methods for burn-up prediction are based on improved representations of neutron energy spectrum and local geometry. The resulting fairly fast and reasonably accurate procedures for determining fuel and cell parameters are especially appropriate for detailed burn-up studies. In addition, higher precision and flexibility in non-destructive gamma-rays technique have been achieved. (auth)

7310 FUEL-BURN-UP PREDICTIONS FOR HEAVY-WATER-MODERATED REACTORS. Rastogi, B. P.; Srinivasan, K. R.; Nakra, A. N. (Bhabha Atomic Research Centre, Bombay). pp 113-116 of Reactor Burn-Up Physics. Vienna; International Atomic Energy Agency (1973).

From IAEA panel on reactor burn-up physics; Vienna, Austria (12 Jul 1971). See STI/PUB-336; CONF-710724-.

Computer codes for estimating the burn-up and other relevant parameters for heavy-water-moderated reactors are described. The model used is to estimate the lattice parameters as a function of point burn-up and then to use them in homogenized two-group diffusion-theory codes. The measured isotopic compositions of plutonium isotopes for the NPD bundle are compared with the calculated values. (auth)

7311 APPLICATION OF A HETEROGENEOUS METHOD IN THE SIMULATION OF HEAVY-WATER-REACTOR OPERATION. Grant, C. (Comision Nacional de Energia Atomica, Buenos Aires); Solanilla, R.; Moldaschl, H. pp 139-153 of Reactor Burn-Up Physics. Vienna; International Atomic Energy Agency (1973).

From IAEA panel on reactor burn-up physics; Vienna, Austria (12 Jul 1971). See STI/PUB-336; CONF-710724-.

The three-dimensional heterogeneous code TRISIC is discussed. TRISIC contains a fuel management program, time-space Xe-concentration, simulation of diagonal control rod and criticality search for these rods, damping of Xe-induced power oscillations by diagonal partial length rods, and the calculation of fuel and coolant temperature distribution. Useful applications of TRISIC regarding the 300 MW(e) ATUCHA Argentine nuclear power reactor core design and operation are described. (auth)

7312 NUCLIDE COMPOSITION OF THE NPD FUEL. Griffiths, J. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 155-161 of Reactor Burn-Up Physics. Vienna; International Atomic Energy Agency (1973).

From IAEA panel on reactor burn-up physics; Vienna, Austria (12 Jul 1971). See STI/PUB-336; CONF-710724-.

The Nuclear Power Demonstration Reactor (NPD) is a heavy-water-cooled and -moderated, horizontal-pressure-tube reactor which has operated at a power level of about 20 MW(e) since 1962. Most of the fuel is in the form of short (50 cm) bundles of Zircaloy-clad, natural-UO_2 fuel pins in a 19-element circular array. Ten of these bundles with irradiations covering the range 1000-10,000 MWd/te have been analyzed for nuclide content. The bundles were selected to have an irradiation history typical of an unperturbed CANDU-type reactor with bi-directional on-power fuelling. In particular, none of the bundles spent significant time near booster fuel or experimental fuel bundles, both of which could perturb the neutron spectrum. Consequently, the resulting nuclide data form an excellent source of information with which to check burn-up calculations. (auth)

7313 SOME BURN-UP EXPERIMENTS IN SWEDEN. Johansson, E. (Aktiebolaget Atomenergi, Studsvik, Sweden). pp 171-190 of Reactor Burn-Up Physics. Vienna; International Atomic Energy Agency (1973).

From IAEA panel on reactor burn-up physics; Vienna, Austria (12 Jul 1971). See STI/PUB-336; CONF-710724-.

Foil experiments on the burn-up dependence of reaction rates in normal clusters of the Ågesta natural $U-D_2O$ reactor are described. Number densities of U and Pu isotopes in special test elements irradiated in the reactor for studies of plutonium recycling are also described. In both cases, cell calculations with the multigroup transport code AEBUXY have been performed for comparison with the experiments. Generally, there are no striking discrepancies in this comparison. There is, however, some uncertainty in the theoretical treatment of the problem due to the complicated boundary conditions when the cluster to be examined is surrounded by clusters of another type or of different burn-up. This difficulty mainly concerns the ratio of epithermal and thermal neutron densities and might be overcome by an iteration between AEBUXY and a macroscopic code. On the experimental side, it seems as if burn-up values determined with the molybdenum method had become too low. Quantitative assay of ^{239}Pu and ^{240}Pu was performed by neutron transmission measurements with a chopper at the low-energy resonances of these two isotopes. This method, practically non-destructive but perhaps somewhat complicated, has given good results for ^{239}Pu but too high values for ^{240}Pu. Probably, Γ_n or Γ_γ (or both) for the 1.056-eV resonance in ^{240}Pu used in the analysis of the transmission data were lower than the true values. Some studies of the use of ^{137}Cs in burn-up determination by gamma measurements are presented. These studies mainly concern the perturbation caused by cesium diffusion in hot fuel and suggest a possibility of overcoming this difficulty or, at least, of reducing the perturbation. (auth)

7314 TWO-PHASE MIXING FOR ANNULAR FLOW IN SIMULATED ROD BUNDLE GEOMETRIES. Singh, K.; St. Pierre, C. C. (Univ. of Windsor, Ont.). Nucl. Sci. Eng.; 50: No. 4, 382-387(Apr 1973).

Turbulent mixing rates between adjacent subchannels were obtained at 50 psia for annular flow of air-water mixtures in a simulated square–square rod bundle geometrical array using a tracer technique. The gap spacing was varied by a factor of 5. Mixing rates were found to be flow regime dependent, decreasing exponentially with subchannel mass flux and quality and increasing with gap spacing. Enhanced liquid interchange was measured in the low quality bubble flow regime and high quality annular flow regime. The results presented are in qualitative agreement with data obtained by other investigators using steam-water at elevated pressures. (auth)

7315 EPITHERM: A CODE FOR CALCULATING LATTICE PROPERTIES OF THERMAL REACTORS. Srinivasan, K. R.; Huria, H. C.; Jain, V. K. (Bhabha Atomic Energy Research Centre, Bombay). pp 401-406 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB–307; CONF-720104–.

A model for the calculation of thermal and epithermal events in a heterogeneous lattice is discussed. The model has resulted from the combination of two codes, EPITHET and THERMNIL, developed separately. Both these codes use multigroup-multiregion collision probability techniques to obtain parameters for a cylindrical cell. The code can also calculate the effective multiplication factor for a specified buckling. (7 references) (auth)

7316 INTEGRAL TRANSPORT THEORY AND NUMERICAL ANALYSIS METHODS IN THE DESIGN OF A HEAVY WATER REACTOR. Bonalumi, R. (CISE Labs., Segrate, Italy). pp 423-444 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB–307; CONF-720104–.

The CIRENE Heavy-Water Reactor Project has stimulated the production of many diversified numerical methods suitable for fast and accurate reactor analysis calculations; the effectiveness of such methods has been widely recognized and their use on small computers is an established fact. The major achievements obtained, with particular emphasis on a few items, either unpublished or likely to stimulate discussions and improvements are outlined. Information is presented concerning reactor physics, spatial calculations, integrated design codes, and dynamic problems. (19 references) (auth)

7317 POWER REACTOR FLUX-TILT PROTECTION INSTRUMENT. Allen, V. H. (Atomic Energy of Canada Ltd., Chalk River, Ont.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 609-617(Feb 1973).

An instrument has been developed as part of a flux-tilt protective system for the light-water-cooled, heavy-water-moderated power reactor (CANDU-BLW) at Gentilly, Quebec. This system is independent of the normal over-power protection instrumentation and is designed to prevent overheating of fuel that could result from spatial flux distortions (or tilts). Three identical instruments are used in the system, each comparing currents from ion chambers located at three positions around the reactor. If flux differences become greater than a preset level a trip signal is generated. The reactor is shut down by dumping heavy water if any two instruments generate simultaneous trip signals. Each instrument contains three linear-logarithmic amplifiers, comparators to sense high flux-tilt levels and logic circuits that combine the comparator signals to produce the final output in the form of relay contact closures. A mixed linear-logarithmic signal is developed from the measured ion chamber current to provide a flux-tilt signal that is non-linear with respect to reactor power. (auth)

7318 BRUCE NUCLEAR PLANT BEGINS TO TAKE SHAPE. Mod. Power Eng.; 66: No. 12, 50-51(Dec 1972).

Canada's 3200 MW Bruce nuclear power plant at Port Elgin, Ontario is shaping up. Unit 2 Reactor will come into service in 1976. Each calandria assembly weighs 800 tons, and was moved 800 miles by water from Montreal. The second reactor for Unit 1 was delivered in October 1972. Placing of concrete for Unit 1 is nearly completed, and that for Unit 3 substructure continues. Four 800 MW Howden and Parsons tandem compound turbogenerators run at 1800 rpm and 600 psig steam pressure at 489°F. These generate 18.5 kW at a power factor of 0.90. Thirty-two Babcock and Wilcox Canada steam generators 96 ft long, and 16 preheaters produce 9,630,000 lb saturated steam/h at 620 psi. Four steam surface condensers are each 62 ft long, 120 ft wide, 4 ft high and contain 40,000 tubes each, with a total cooling surface of 450,000 sq ft condensing 5,651,000 lb/h. Sixteen heavy water transport pumps have a capacity of 43,000 US gal/min at 650 ft head, 1250 psig and 1800 rpm. 11,000 hp Westinghouse motors drive the pumps. Eight moderator heat exchangers have a capacity of 300 million Btu/h transfer and contain 3100 nickel-iron-chrome alloy tubes for 1500 psi. Enriched booster fuel is arranged in 16 assemblies in different parts of the core to obtain reactivation after poison-out. Digital computers control numerous functions. (CA)

Power Reactors, Breeding

Refer also to abstracts 5830, 7281, 7361, 7427, and 7520.

7319 (AAEC/LIB/Bib-376) FAST BREEDER REACTORS. A Bibliography. McDonald, C. J. (comp.) (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Dec 1972. 60p. Dep. NTIS (U. S. Sales Only) $5.00.

Two hundred and sixty-seven references on fuel cycles, design and performance, and reactor physics for fast breeder reactors from INIS and NSA for the period of 1968 to September 1972 are provided. Arrangement is alphabetically by author within each year. (AT)

7320 (AI-AEC-13051) FUELS, MATERIALS, AND CONTROL ROD DEVELOPMENT PROGRAMS. Quarterly Technical Progress Report, October-December 1972. (Atomics International, Canoga Park, Calif.). 15 Feb 1973. Contract AT (04-3)-824. 51p. AT $5.45.

The radiation effects on the mechanical properties of Type 316 stainless steel are studied. The effects of fast neutrons on the generation of helium in ^{10}B, ^{63}Cu, and ^{65}Cu are measured. The design parameters and performance requirements for tantalum control rods for an LMFBR are described. (DCC)

7321 (AI-AEC-13052) SODIUM TECHNOLOGY AND COVER GAS SEAL DEVELOPMENT PROGRAMS. Quarterly Technical Progress Report, October-December 1972. Guon, J.; Eichelberger, R. L.; McKisson, R. L. (Atomics International, Canoga Park, Calif.). 15 Feb 1973. Contract AT(04-3)-824. 128p. AT $5.45.

The development and testing of components for a liquid sodium test loop are described. Cleaning and storage requirements for liquid sodium coolant loop components are presented. The friction test program for the analysis of materials for use in the FFTF cooling system is described. The testing of cover gas seals for LMFBR and FFTF cooling systems is reviewed. (DCC)

7322 (ANL-7974) SODIUM TECHNOLOGY QUARTERLY REPORT, July-September 1972. Kesser, G. M. (comp.) (Argonne National Lab., Ill.). Mar 1973. Contract W-31-109-eng-38. 64p. AT $5.45.

Work has been continued on the design and testing of a multipurpose sampler for use at FFTF; the sampler will provide the capability for obtaining overflow sodium samples, filtering flowing sodium for assay of particulates, and equilibrating metal specimens. Efforts were continued on the preparation of RDT standards on specifications for measuring and controlling the purity of sodium and cover gas and on laboratory work related to the methods to be used for purity measurements. Work was continued on the design and fabrication of a cover-gas analysis system for separating ^{23}Ne from noble-gas fission products in cover gas and on the testing of a laboratory prototype of a system for monitoring the ^{135}I content of reactor primary sodium. Development of a calculational model to describe the generation and transport of tritium in an LMFBR was begun, and on-line monitors are being designed and fabricated for measurement of tritium in sodium and cover gas; other work on meters has included testing of on-line monitors for oxygen, carbon, and hydrogen and leak detectors for steam generators, and testing of meter modules. Investigations of oxygen-hydrogen interactions in sodium have been continued. Work has continued on the program to determine the integrated effects of fast-neutron and sodium environments on the properties of stainless steel and to develop post-exposure testing methods for the stainless steel specimens; in the study of carbon transfer in sodium-steel systems, a mathematical model is being developed for predicting the magnitude and rate of carbon migration in reactor sodium systems. (auth)

7323 (ANL-RDP-15) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, MARCH 1973. (Argonne National Lab., Ill.). 26 Apr 1973. Contract W-31-109-eng-38. 188p. AT $7.60.

Highlights of project activities for March 1973 are summarized. The EBR-2 operations and engineering development programs are reported. Heat transfer and fluid flow studies for LMFBR design support are reviewed. The development of LMFBR instrumentation is summarized. Monitoring and sampling methods and devices are examined for liquid sodium systems. Studies of LMFBR fuels and materials, fuel cycles, physics, and safety are described. Thermal plume dispersion from reactor outfalls was investigated. (DCC)

7324 (CEA-CONF-2140) FUEL–COOLANT INTERACTIONS: EXPERIMENTAL STUDIES AND THEORETICAL APPLICATION IN THE CASE OF FAST REACTORS. Amblard, M.; Syrmalenios, P.; Costa, J. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 1972. 27p. (In French). (CONF-721006-5). Dep. NTIS (U. S. Sales Only).

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (F. R. Germany) (9 Oct 1972).

Two experimental studies on the fusion of UO$_2$ separated from liquid Na by a stainless steel wall were described. These studies confirmed the dispersion of the fuel in the coolant. Granules whose dimensions can be as small as several tens of microns were obtained. It was established that when the ratio of the mass of Na to the mass of UO$_2$ tends toward 0.1 the fragmentation involves only a relatively small proportion of the fuel. The studies also showed the difficulty of putting the UO$_2$ and liquid Na in contact across a stainless steel wall. Some results of calculations made with the CORFOU code, which describes in detail the thermal exchanges between UO$_2$, the liquid sodium, and the steam are given. Because the data furnished are qualitative and insufficient, no attempt was made to adjust the parameters of the code. (tr-auth)

7325 (CEA-R-3501(3)) MANUFACTURE OF THE FIRST CORE OF RAPSODIE. Part III. Special Technical Problems. Masselot, Y.; Bataller, S.; Ganivet, M.; Guillet, H.; Robillard, A.; Stosskopf, F. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Mar 1973. 38p. (In French). (EUR-3862(3)). Dep. NTIS (U. S. Sales Only) $4.00.

The process, results, and special technical problems involved in the manufacture of the first core of the fast reactor RAPSODIE are described. The following problems are studied: systematic deviation of the plutonium content in fuel, variation of the stoichiometry of sintered mixed oxide, and appearance of a second phase in the solid solution (U, Pu)O$_2$. (auth)

7326 (CONF-730326–1) STATUS OF SODIUM CLEANING PROCESSES IN THE LMFBR PROGRAM, USA. Taylor, G. R.; Bishop, E. C.; Cooper, M. H.; Perrone, P. (Westinghouse Electric Corp., Pittsburgh, PA. Advanced Reactors Div.; Division of Reactor Development and Technology (AEC), Washington, D. C.). 1973. Contract AT(11-1)-3045. 37p. Dep. NTIS $4.00.

From international working group on sodium cleaning; Dounreay, Scotland, UK (26 Mar 1973).

The advantages, disadvantages, and efficiency in the use of alcohol, vacuum distillation, moist nitrogen, or steam processes for cleaning reactor components exposed to sodium are discussed. The alkali metal cleaning facility will provide non-radioactive residual sodium removal. (FS)

7327 (COO-2250-1) HETEROGENEOUS EFFECTS IN FAST BREEDER REACTORS. Gregory, M. V.; Driscoll, M. J.; Lanning, D. D. (Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering). Jan 1973. Contract AT(11-1)-2250. 266p. (MITNE-142). Dep. NTIS $7.60.

Heterogeneous effects in fast breeder reactors are examined through development of simple but accurate models for the calculation of a posteriori corrections to a volume-averaged homogeneous representation. Three distinct heterogeneous effects are considered: spatial coarse-group flux distribution within the unit cell, anisotropic diffusion, and resonance self-shielding. An escape/transmission probability theory is developed which yields region-averaged fluxes, used to flux-weight cross sections. Fluxes calculated by the model are in substantial agreement with S$_8$ discrete ordinate calculations. The method of Benoist, as applied to tight lattices, is adopted to generate anisotropic diffusion coefficients in pin geometry. The resulting perturbations from a volume-averaged homogeneous representation are interpreted in terms of reactivities calculated from first order perturbation theory and an equivalent "total differential of k" method. Resonance self-shielding is treated by the f-factor approach, based on correlations developed to give the self-shielding factors as functions of one-group constants. Various reference designs are analyzed for heterogeneous effects. For a demonstration LMFBR design, the whole-core sodium void reactivity change is calculated to be 90% less positive for the heterogeneous core representation compared to a homogeneous core, due primarily to the effects of anisotropic diffusion. Parametric studies show at least a doubling of this negative reactivity contribution is attainable for judicious choices of enrichment, lattice pitch and lattice geometry (particularly the open hexagonal lattice). The fuel dispersal accident is analyzed and a positive reactivity contribution due to heterogeneity is identified. The results of intra-rod ^{238}U activation measurements in the Blanket Test Facility are analyzed and compared to calculations. This activation depression is found to be of the order of 10% (surface-to-average) for a typical LMFBR blanket rod and is ascribed to the effect of heterogeneous resonance self-shielding of ^{238}U. Heterogeneous effects on the breeding ratio are studied with the conclusions that accounting for resonance self-shielding reduces the total breeding ratio by over 10%, but heterogeneous effects are not important for breeding ratio calculations. (auth)

7328 (EURFNR-1072) PRAWDA 2: A FORTRAN PROGRAM FOR THE THERMAL AND HYDRAULIC DESIGN OF

FAST REACTORS. User Manual. Doetschmann, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Nov 1972. 62p. (KFK-1698). Dep. NTIS $5.25.

Work performed under United States–Euratom Fast Reactor Exchange Program.

PRAWDA2 is a FORTRAN-4 code for thermal and hydraulic design of fast reactor cores consisting of bundled fuel rods with single phase coolant. Basic design criterion is the analysis of the most limiting cooling channel. The influences of coolant mixing and of the subchannels at the boundary of a subassembly on the coolant temperature rise are taken into account. It is possible to consider some global core effects (such as flux shape factor etc.) on the core average outlet temperature and interaction with the reactor heat transfer system. PRAWDA2 is a useful tool during preliminary reactor thermal design, specially for parametric analysis in order to assess the most important parameters and their optimal choice with regard to the highest plant efficiency. (4 references) (auth)

7329 (EURFNR-1074) BREDA: A COMPUTER MODEL FOR THE DEFORMATION OF A SODIUM-COOLED FAST BREEDER FUEL PIN UNDER TRANSIENT LOAD. Kuczera, B. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Dec 1972. 51p. (KFK-1729). Dep. NTIS $4.75.

Work performed under United States–Euratom Fast Reactor Exchange Program.

BREDA is part of a computer code system designed for the overall analysis of hypothetical accidents in LMFBRs. The model predicts the behavior of a single fuel pin during fast reactor transients. The material displacement and change in pin geometry cause a feedback to the nuclear kinetics and thermodynamics of the power excursion. The calculations of the pin behavior are based on the thermoelastic stress–strain relations, the clad tube is treated as a material with elastic, perfectly plastic properties. Molten fuel can cause pressurizing in the pin. There is a pin burst criterion introduced. In a sample problem the experiment S-3 (TREAT) is analyzed. (22 references) (auth)

7330 (EURFNR-1077) FAST REACTOR PROGRAMME. Fourth Quarter 1972 Progress Report. Hoekstra, E. K. (comp.) (Reactor Centrum Nederland, Petten). Feb 1973. 94p. (RCN-183). Dep. NTIS (U. S. Sales Only) $5.45.

Results are given of spectrum and fission product reactivity worth measurements performed in the STEK reactor core 3000. A post-irradiation examination of fuel pin R54-F22A after failure at a canning temperature of 975°C and internal pressure of 52 bar maintained for 230 minutes is reviewed; initial results of the fifth loss-of-cooling experiment R63-L05 are described. Progress on lattice parameter, phase diagram and temperature gradient studies on U(C,N) and preparation of uranium carbides are reported. A distillation method has been tried out as part of the analysis of impurities in sodium. A research programme on the influence of neutron radiation on the mechanical properties of the austenitic steel 1.4948 to be used in the SNR-300 reactor vessel is in the process of being set up. The effects of condensing of water, carbon tetrachloride and Freon 113 vapours on the stability of aerosols are reported. In the field of heat transfer in sodium, single-phase experiments in a four-rod bundle and planned two-phase experiments in 12- and 28-rod bundles with relevant heater development are described; a comparison is given between the results of heat transfer experiments in air performed on the roughened rods LUCY-104 and -107 and those performed on the smooth rod LUCY-102; flow velocity and wall shear stress data calculated with the one-dimensional code CACES: TAU and the two-dimensional code CACES: VESPRI are compared. (auth)

7331 (GEAP–12389) THERMODYNAMIC DATA PROGRAM INVOLVING PLUTONIA AND URANIA AT HIGH TEMPERATURES. Quarterly Report No. 22, November 1, 1972–January 31, 1973. Aitken, E. A.; Dutina, D.; Adamson, M. G.; Evans, S. K.; Ludlow, T. E. (General Electric Co., Pleasanton, Calif. Vallecitos Nuclear Center). Feb 1973. Contract AT(04-3)-893. 32p. Dep. NTIS $3.75.

Progress is reported on the continuing scope of work related to fission-product cladding interaction and sodium-fuel chemical interactions. In addition, an analysis and experimental study is presented on the use of oxygen absorbers inside an LMFBR fuel pin to maintain a low oxygen activity and thereby decrease the chance for cladding attack. (auth)

7332 (GEAP–18322-4) LMFBR SHIELDING DESIGN EXPERIMENTS AND METHODS EVALUATION. Fourth Quarterly Report, October–December 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Jan 1973. Contract AT (04-3)-189. 90p. Dep. NTIS $5.45.

Both experimental and analytical work on axial and radial shields is being conducted with the experimental part being performed at the Oak Ridge National Laboratory (ORNL) Tower Shielding Facility. Activities and technical progress for the period October through December 1972 are reported. The major topics include program definition and scheduling, experimental measurements, analytical studies, and comparisons between experimental and calculated data. (auth)

7333 (GEAP–13925) CAPSULE B9D IRRADIATION AND POST IRRADIATION EXAMINATION. Bohaboy, P. E.; Craig, C. N.; Stimmell, G. L.; Regimbal, J. J.; Novak, P. E. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Dec 1972. Contract AT(04-3)-189. 61p. Dep. NTIS $5.25.

Two mixed-oxide fuel rods were defected while operating at an average linear power of 15 kW/ft. The fuel rods were axially aligned and were essentially identical except for the defect location. The top fuel rod (B9D-1) contained a defect in the gas plenum; the bottom fuel rod (B9D-2) was defected at the axial midpoint of the 4.25 in. fuel column. Irradiation in the defected condition continued until an average fuel burnup of 6600 MWd/Te was attained. Samples of fission gases released by the failed rods were taken and analyzed at different time intervals during the test. Results of post-irradiation examination of the fuel, capsule hardware, and sodium coolant are presented. The forced circulation capsule (FCC) design concept proved to be both a versatile and valuable vehicle for testing defected fuel. The design permits precise independent control of the bulk sodium temperature, the sodium velocity, and the average fuel rod linear power; therefore, it can be used to simulate a large variety of test conditions. The gas sampling system allowed the experimenter to observe the effect of reactor operational changes on the fission gas release characteristics. Future FCCs could be designed to monitor the rate of fission gas release following failure of a high burnup fuel rod. Capsule hardware and sodium can be analyzed for fuel and fission products eroded from the failed rods by the flowing sodium. The location of these products in the loop can also be determined. The type of information that can be obtained from the defected fuel FCC experiments provides valuable input for future LMFBR-design operational and safety decisions. It was found that the defect location had little or no effect on the resulting diameter increase in the failed fuel rods; metallographic techniques proved to be successful at retaining the structure of the sodium-fuel reaction product in the failed fuel; metallographic examination showed that fuel sodium reaction product filled the fuel cladding gap along the entire length of both fuel rods; fuel sections immediately adjacent to the fuel defect contained the smallest quantity of reaction product in the fuel clad gap; no reaction product was found to be extruding into the gap between the UO_2 blanket pellets and cladding; percentage of fuel released from the failed rods was less than 0.015% of the total inventory; fission products were generally found to be deposited on the capsule walls, except Cs-137, Sb-125 and Sr-90, which were retained in the sodium; and of the total fission products found in the sodium and on the capsule walls, 90.2% were Cs-137 and 8.4% were I-131. (auth)

7334 (GEAP–13935) STOICHIOMETRY EFFECTS ON $\int Kd\theta$ OF $(Pu,U)O_{2-x}$ IN PILE. Cantley, D. A.; Rubin, B. F.; Craig, C. N. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Jan 1973. Contract AT(04-3)-893. 50p. Dep. NTIS $4.00.

The effect of oxygen-to-metal (O/M) ratio (1.94, 1.97, 2.00) on the integrated conductivity for equiaxed and columnar grain growth and melting in mixed oxide fuel was measured in a thermal flux. The results indicate that fuel O/M effects were small compared to uncertainties associated with fuel-to-cladding gap conductance. As a result of the uncertainty in fuel-to-cladding gap conductance, it was calculated that the power required to produce melting in a fast reactor would have an uncertainty of ~3.5 kW/ft for gap conductances ranging between 1000 and 2000 Btu/hr-ft^2-°F. Integrated conductivity and temperatures for equiaxed and columnar grain growth were determined to increase as the fuel O/M decreased. For fuel-to-cladding gap conductances ranging between 1000 and 2000 Btu/h-ft^2-°F: 1) the temperature at which equiaxed grain growth occurred in 2.00 O/M fuel was ~150°C below that in 1.94 O/M fuel; 2) the temperature at which columnar grain growth occurred in 2.00 O/M fuel was 200°C below that in 1.94 O/M fuel; 3) equiaxed grain growth occurred in the temperature range of 1500 to 2000°C and columnar grain growth in the range of 1800 to 2400°C. Fuel O/M was found to have a small effect on integrated conductivity to melting. On a nonstatistical basis, the 1.97 O/M fuel exhibited a 4 to 5% higher integrated conductivity to melt than 1.94 and 2.00 O/M fuel. The difference between the initial and end-of-life shift in the molten boundary was calculated to result in a 1 to 2% increase in the integrated conductivity to melting. (auth)

7335 (JAPFNR-88) DEVELOPMENT OF CONTROL ROD WORTH CALCULATIONS BY THE MONTE CARLO METHOD. (Fuji Electric Co. Ltd., Tokyo (Japan)). Mar 1972. 22p. Dep. NTIS (U.S. Sales Only) $3.25.

For Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan.

The Monte Carlo computer program MONEX has been developed for fast reactor calculations. Geometry routines for the spherical, RZ-, and XYZ-systems have been developed for most practical applications in the field of fast reactors. Typical numerical results obtained from MONEX calculations of JOYO mock-up control rod experiments are presented to demonstrate the flexibility and computational speed achieved through the use of MONEX techniques. A cell-calculation is also performed to present the applicability of MONEX to the problem of anisotropic neutron diffusion. (auth)

7336 (JAPFNR-89) PERFORMANCE OF HIGH TEMPERATURE NEUTRON DETECTOR. Kawakami, T.; Kakuta, T.; Kawaguchi, C. (Japan Atomic Energy Research Inst., Tokai. Tokai Research Establishment). Dec 1971. 49p. (JAERI-Memo-4665). Dep. NTIS (U. S. Sales Only) $4.00.

For Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan.

A high temperature neutron detector scheduled to be used in the fast breeder type experimental nuclear reactor "JOYO" was tested under irradiation and high temperature environments. The detector tested was a model SK-401 high temperature gamma-ray compensated ionization chamber manufactured by Reuter Stokes Co., Ltd. and had an operating temperature of 650°C. A performance test under heating up to 600°C, gamma-ray irradiation up to 5.67×10^6R, and neutron irradiation up to 3.28×10^{18} nvt was carried out; the results obtained before and after the irradiation were compared and evaluated. Although the results are considered to be unsatisfactory, it is concluded that the detector can be used in a high temperature reactor environment. (auth)

7337 (KFK-1723) ISOTHERMAL SODIUM FLOW EXPERIMENTS WITH A MODEL FUEL-ELEMENT COMPOSED OF RODS WITH 6 INTEGRAL FINS AS SPACERS. Baumgaertner, E.; Borgstedt, H. U.; Drechsler, G. (Kernforschungszentrum, Karlsruhe (West Germany)). Feb 1973. 48p. (In German). Dep. NTIS (U. S. Sales Only) $4.50.

A model of a fuel element bundle composed of 1.4961 rods with 6 helical fins as spacers was investigated in an isothermal sodium flow over 1900 hours at temperatures of 600°C and sodium velocities of 4.7 m/sec. The 61-rod cluster was installed in hexagonal shrouds of different widths. The behavior of the points of support of the fins and the corrosion effects on surfaces and welds were examined. 10 references. (auth)

7338 (KFK-1782) PRELIMINARY ANALYSIS OF THE PREDISASSEMBLY PHASE OF THE UNPROTECTED OVERPOWER TRANSIENT ACCIDENT FOR SNR-300. Kastenberg, W. E.; Rumble, E. T. III. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Systemtechnik und Reaktorphysik). Mar 1973. 28p. Dep. NTIS (U. S. Sales Only) $3.50.

A simplified model of the predisassembly phase of the unprotected overpower transients in LMFBR's is presented. The model includes fuel movement and sodium expulsion as a result of the molten fuel-coolant thermal interaction in the channels. The SNR-300, a prototype/demonstration plant is analysed and the results compared to an earlier set of calculations using the SAS-VENUS computational models. The previous analysis neglects fuel movement. The results indicate that substantial reductions in the severity of the transient, as measured by molten fuel produced, the thermal energy generated, and the final temperatures, can be obtained when fuel movement is included. 11 references. (auth)

7339 (ORNL-TM-4231) FAST REACTOR ANALYTICAL SHIELDING MONTHLY PROGRESS REPORT FOR JANUARY AND FEBRUARY 1973. 189a No. 10318, Activity No. 40 01 03. Mynatt, F. R.; Maerker, R. E. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 34p. AT $4.00.

Progress made by the ORNL Neutron Physics Division in Fast Reactor Analytical Shielding Research during the months of January and February, 1973 is summarized. Calculations were performed with discrete ordinates and Monte Carlo methods for a conceptual FTR branch-arm-pipe shield design with a streaming path, and an update of the 3-D MORSE calculation of the FTR stored-fuel fission power is reported. Continuing work on analysis of the TSF FTR iron-polyethylene secondary gamma-ray experiment and DOT calculations of the large sodium experiment are reported. (auth)

7340 (RDT-C-4-6-T(4-73)) IN-CORE PERMANENT-MAGNET FLOW-THROUGH-TYPE FLOWMETER FOR LIQUID METAL SERVICE. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Apr 1973. 25p. RSO.

The requirements for the design, fabrication, testing, and inspection of sodium-immersible in-core permanent-magnet flow-through-type flowmeters are presented. Flowmeters of this type are used to measure the sodium flow through various types of fuel, blanket, control, and experimental assemblies in reactors germane to the LMFBR program at temperatures up to 1000°F. (auth)

7341 (WARD-3045-T-2-C-7) VALIDATION OF HIGH TEMPERATURE DESIGN METHODS AND CRITERIA QUARTERLY PROGRESS REPORT FOR PERIOD ENDING NOVEMBER 30, 1972. Bishop, E. C. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Feb 1973. Contract AT(11-1)-3045. 62p. AT $5.45.

The tensile properties of Type 304 and Type 316 stainless steel structures which represent LMFBR core components are measured. Design parameters and results of structural testing of the Multiloading Test Facility are presented. Thermal stress analysis for the FTR intermediate heat exchanger inlet nozzle is included. (DCC)

7342 (WARD-3045-T-3-11) OXIDE FUEL ELEMENT DEVELOPMENT QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING DECEMBER 31, 1972. Boltax, A.; Saling, J. H. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Feb 1973. Contract AT(11-1)-3045. 86p. AT $5.45.

The irradiation testing of stainless steel clad mixed oxide fuel pins in the EBR-2 is described. The analysis of strain in the stainless steel cladding is presented. The design parameters and thermal-hydraulic characteristics of LMFBR grid type mixed oxide fuel assemblies are calculated. (DCC)

7343 IMPROVEMENTS IN OR RELATING TO LIQUID METAL COOLED FAST REACTORS. Barber, A. (to United Kingdom Atomic Energy Authority). British Patent 1,303,055. 17 Jan 1973. Filed date 13 Aug 1969. 4p.

In this reactor, the core is immersed in liquid metal in a tank, and the coolant circuit includes the reactor core and a heat exchanger, with a liquid metal pump. One or more rotatable shields are supported independently of and above the core, and a duct is provided to conduct the coolant from the core outlet to the heat exchanger and thence to the liquid metal in the tank. A predetermined leakage path for the coolant is provided at the core outlet to the liquid metal in the tank. This path is defined by a radial clearance or clearances at one or more of the circumferential surfaces of the rotatable shields. The core may have a support skirt suspended from the roof of a containment vessel for the tank. The pump supplies liquid metal coolant from the lower region of the tank to the core inlet. The duct to the heat exchanger passes through the support skirt, and apertures in the latter discharge to the liquid metal in the tank. (UK)

7344 EXPERIMENTAL STUDIES ON ISOTOPIC CHANGES OF FUEL IN FAST REACTORS AS A FUNCTION OF IRRADIATION. Robin, M.; Bouchard, J. (CEN, Fontenay-aux-Roses, France). pp 191-195 of Reactor Burn-Up Physics. Vienna; International Atomic Energy Agency (1973). (In French).

From IAEA panel on reactor burn-up physics; Vienna, Austria (12 Jul 1971). See STI/PUB-336; CONF-710724-.

The experimental study on isotopic changes of fuel in fast reactors gives two kinds of information: (a) relative values of cross sections deduced from measurements performed on fuel or pure isotopes irradiated in various fast spectra; (b) a direct check of the set of formulas used for burn-up calculations for core assemblies and blankets. Very accurate physico-chemical measurements are needed. The techniques used are practically the same as the ones developed on thermal reactor fuels. The main features of these techniques are recalled; then the various measurements made on fuels irradiated in fast spectra are described. (auth)

7345 CALCULATED RADIATION PROPERTIES OF SPENT PLUTONIUM FUELS. Bell, M. J. (Oak Ridge National Lab., TN). Nucl. Technol.; 18: No. 1, 5-14(Apr 1973).

The ORIGEN computer code has been used to compute the time-dependent thermal power, photon spectrum, and neutron production rate resulting from fast- and thermal-neutron-induced fission of ^{235}U and ^{239}Pu fuels. Computed afterheats and photon spectra of fission products resulting from thermal fission of ^{235}U are shown to be in good agreement with published data, and computed radioactivities and thermal power of plutonium irradiated to low exposures in both thermal- and fast-neutron spectra are found to agree well with experimentally measured properties. Radioactive decay of the actinide elements is calculated to contribute 10 to 25%

of the thermal power of spent low enrichment ^{235}U fuels at postirradiation times between one day and three years. Gamma radiation per unit mass of 30-day-cooled LMFBR core fuel is calculated to exceed that from 90-day-cooled PWR fuel by a factor of 30 in the higher energy groups, and spontaneous fission neutron production per gram of spent LMFBR core fuel is found to exceed that of PWR fuel by a factor of 3 at these times. (auth)

7346 THREE-DIMENSIONAL SPACE SYNTHESIS IN HEXAGONAL GEOMETRY. Buckel, G. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.); Delabaye, M.; Hoenraet, C.; Pilate, S. pp 521-529 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

The computer code KASY, written at Karlsruhe for IBM 360, solves the three-dimensional diffusion equation by means of a synthesis method using available two-dimensional trial functions. It was originally written for the geometries XY/Z, RZ/θ and Rθ/Z. The flux synthesis method used in KASY was successfully tested with results obtained by a direct XYZ-three-dimensional program, and, therefore, extensively applied to typical fast-breeder applications. The extension of the KASY synthesis technique to a fourth geometry, hexagonal/Z, which means that a triangular mesh is used in the transversal plane of the reactor, is described. One two-dimensional diffusion code using such a triangular mesh, TREPAN, was existing at Belgonucléaire (BN) for IBM 360. In close cooperation between GfK and BN, the following work was completed, starting from the original form of the codes KASY and TREPAN: new formulation of the calculation of the synthesis coefficients in KASY, adapted to the case of triangular meshes; new handling of the geometrical data in KASY taking into account the hexagonal geometry; transfer of flux distributions generated by TREPAN to KASY as trial functions; compatibility of all input data of both programs, primarily cross sections. After completion of the programming tasks tests have been made and compared with direct three-dimensional results. These tests are fully satisfactory since the main results of a synthesis calculation using two and three trial functions, k_{eff} and flux-distributions, are reasonably close to the direct results, using a total computer time around a factor 10 lower. (7 references) (auth)

7347 LMFBR INSTRUMENTATION AND CONTROL. Pflasterer, G. R. (General Electric Co., Sunnyvale, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 586-593 (Feb 1973).

Reactor control and core surveillance instrumentation are important to the safety and economics of LMFBR design and operation. Considerable world wide effort has been expended during the past 10 years on such instrumentation. The results of these efforts in France will be tested in Phenix and the U. K. will test theirs in the PFR reactor when these reactors start up in 1973. Meanwhile, development efforts are continuing on a broad front in the U. S., Europe, Japan on LMFBR instrumentation, particularly in the areas of: high temperature neutron detection; acoustic monitoring; core exit and entrant coolant monitoring; sodium process instrumentation; and detection of incipient failure of critical sodium system components (e.g. reactor vessel, heat exchanger tubes, pipes). LMFBR core instrumentation and control development programs in the U. S. and Europe are reviewed. (auth)

7348 BREAKDOWN PULSE NOISE IN REACTOR INSTRUMENTATION CABLE SYSTEMS. Phillip, L. D.; Schemmel, R. R.; Stringer, J. L. (Westinghouse Hanford Co., Richland, WA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 594-602(Feb 1973).

Breakdown pulse noise (BPN) is defined as noise pulses, which are indistinguishable from typical neutron counter pulses, generated within insulation of instrumentation cables and seals having dc voltage applied at elevated temperatures. Possible mechanisms causing BPN are discussed. The experimental technique for measuring BPN is described. Presented data show the importance of backfill gas, density, purity, and surface finish on the performance of insulators for use in cables and seals of reactor instrumentation. (auth)

7349 PRELIMINARY TEST OF THE THREE-WIRE-TC SODIUM TEMPERATURE-FLUCTUATION SENSOR FOR THE TRANSIT-TIME FLOWMETER AND FOR THE LMFBR SUBASSEMBLY EARLY-WARNING. Kuwabara, J. (Japan Atomic Energy Research Inst., Tokai); Hasegawa, K.; Nozaki, M.; Kobayashi, K.; Murata, H. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 618-626(Feb 1973).

The three-wire-TCs have been proposed to be replaced with the current outlet thermocouples to obtain much information from the limited number of sensors and to detect the local blockage in the LMFBR subassembly. A preliminary application test of the new sensors to the transit-time flowmeter and to the early-warning of local blockage in the LMFBR subassembly is performed utilizing an existing sodium loop for the first time. Test proves that the new sensor is an excellent temperature-fluctuation sensor because of its high speed response and sharp point-sensitivity, and can improve performance of a transit-time-flowmeter. Early-warning of local blockage in the LMFBR subassembly seems very promising. A concept for the subassembly outlet monitoring and a process-filter technique for reception of signals in background noise are discussed. (17 references) (auth)

7350 DEVELOPMENT OF A THERMAL BREEDER REACTOR IN THE NETHERLANDS. Went, J. J. (Keuring van Electrotechnische Materialen, NV, Arnhem, Netherlands). Mitt. Ver. Grosskesselbesitzer; 51: No. 6, 431-436(1971). (In German).

From VGB general meeting; Munich, Germany (29 Jun 1971).

A general description of breeding as an energy source is followed by a description of the advantages and disadvantages of the homogeneous suspension reactors. The special features of the KEMA suspension test reactor (KSTR) are discussed. (GE)

7351 HANDLING OF THE CORE ELEMENTS OF THE REACTOR SNR 300. Althaus, D. (Internationale Atomreaktorbau GmbH, Bensberg, Ger.). Kerntechnik; 15: No. 3, 105-113(1973). (In German and English).

A review of the particular features and of specific problems in the manipulation of fuel elements of sodium-cooled fast reactors is presented. Overall design criteria and the main distinctive features of the manipulation concepts developed are compared. Some manipulation system components are briefly described. (GE)

7352 DEVELOPMENT OF FAST REACTORS. II. Rockstroh, R. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 15: No. 7, 213-219(Jul 1972). (In German).

7353 LINEAR MODEL FOR DYNAMIC ANALYSIS OF FAST OXIDE REACTORS. Hermansky, B. (Technical Univ., Prague). Kernenergie; No. 7, 219-224(Jul 1972).

Differential equations describing the dynamic behavior of nuclear reactors were formulated. Using a linear approximation, the general transfer function of a reactor with thermal feedback is derived. While the kinetics of the reactor is described using a one-point model, for the feedback mechanisms a detailed distributed parameter model is introduced. (auth)

7354 POSITIONING CONTROL EQUIPMENT FOR FUEL ELEMENT AND BREEDER ELEMENTS IN THE SODIUM-COOLED REACTOR SNR 300. Hans, R.; Maxam, S. (Internationale Atomreaktorbau GmbH, Bensberg, Ger.). Siemens-Z.; 46: No. 10, 779-783(1972). (In German).

The main problems in selecting measuring methods for positioning control equipment for the Fast Cooled Sodium Reactor SNR 300 are: high temperature technique, radiation dose, and availability. Under these conditions, the number of physical effects which could be used are strongly reduced from the start. The developed positioning control equipment is operated by a combined mechanical electromagnetic process. (GE)

7355 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Hind, J. R. (to United Kingdom Atomic Energy Authority). British Patent 1,307,680. 21 Feb 1973. Filed date 2 Oct 1969. 5p.

Reference is made to liquid metal cooled fast breeder reactors. Such reactors have a tank that contains both the reactor core and a pool of liquid metal in which the reactor core is immersed, with containment surrounding the tank that serves as a leak jacket for any liquid metal leaking from the tank. The tank, containment vessel and reactor internals are suspended from a roof spanning a concrete vault, requiring that the roof be capable not only of withstanding the dead weight of the two vessels, the reactor internals and the Na, but also, for pressure loads which might be generated within the tank in the event of an incident involving fuel/coolant reaction. The object of the system is to provide a reactor in which complexities of manufacture and capital costs can be reduced. The primary containment comprises a spherical metal containment vessel having a necked top opening. A metal vessel provides a tank of similar shape, but smaller than the containment vessel and contained therein with clearance. The tank has the reactor core internals suspended from its neck, and the tank itself is suspended from the containment vessel neck. The containment vessel is suspended at its neck from a metal strutted structure carried at the top of a concrete vault. A rotatable biological shield is provided. (UK)

7356 IMPROVEMENTS IN OR RELATING TO VESSELS FOR CONTAINING HOT LIQUIDS. Taylor, R. S.; Davies, I. L. (to Taylor Woodrow Construction Ltd.). British Patent 1,308,180. 28 Feb 1973. Filed date 23 Nov 1970. 4p.

Reference is made to pressure vessels for liquid metal cooled nuclear reactors. If the level of hot liquid rises and falls, undesirable variations of thermal stress occur at that part of the vessel in contact with the surface of the liquid. In the system described the vessel has a cavity for containing the hot liquid and a gas layer is provided to separate the liquid from the cavity walls. (UK)

Research, Test, and Experimental Reactors

Refer also to abstracts 5778, 7321, 7322, 7341, and 7348.

7357 (CEA-CONF-2145) USE OF LOW- AND MEDIUM-POWER PILES FOR STUDIES OF REACTOR ENGINEERING. Bernot, J.; Rossillon, F. (Commissariat a l'Energie Atomique, Paris (France)). 1972. 11p. (In French). (CONF-721138-2). Dep. NTIS (U. S. Sales Only).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972).

The development of research reactors of greater and greater power does not make the reactors of low or medium power useless. The engineering studies of reactors are not limited to tests of materials under high flux. Numerous analytical studies of materials under irradiation are adequate with medium flux. In numerous cases the reactors of low and medium power offer, in addition to the economic advantages, flexibility of operation, ease of use, and low γ heating. In this framework the possibilities for the use of low- and medium-power reactors and the conditions of their utilization are analyzed. (tr-auth)

7358 (CEA-CONF-2152) NEUTRONICS OF MEDIUM-POWER REACTORS. Desandre, C. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). 1972. 22p. (In French). (CONF-721138-5). Dep. NTIS (U. S. Sales Only).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972).

Neutron spectroscopy has been developed considerably during the course of the last ten years and numerous devices have been installed near research reactors. The medium-power reactors are particularly well adapted to this technique; in France these reactors are equipped with devices in the reactor and with devices in the output beam. These two types of installations are described. The TRITON reactor has an installation on the output beam which is used to illustrate this type of device. A diagram indicates the different sequences to be followed for this facility. (tr-auth)

7359 (CONF-721138-1) SOURCES OF COLD NEUTRONS. Ageron, P.; Astruc, J. M.; Cribier, D.; Der Nigohossian, G.; Perves, J. P.; Roubeau, P.; Verdier, J. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Sep 1972. 16p. (In French). (SM-165-27). Dep. NTIS (U. S. Sales Only).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972).

The possibility of having sources giving, at the outlet of a reactor channel, a neutron spectrum displaced toward the longer wave lengths offers experimental possibilities in a very wide range: physics of solids and liquids, nuclear physics, chemistry, biochemistry, and technology. These neutrons can be produced by using liquid hydrogen or deuterium with which it is possible to optimize the selection and the dimensions. The problems of refrigeration, hydrodynamics of the circuits, selection of the materials, and safety connected with these installations were resolved by the C.E.A. both on very large installations as the cold source of the Grenoble high flux reactor (7 kW at 25°K and 25 l of liquid deuterium) and on small sources such as the cold source of the Saclay EL3 reactor (100 W at 20°K and and 0.51 l of liquid hydrogen). The principal characteristics of these installations are given by reporting the technological problems resolved in order to construct them and assure operation. (tr-auth)

7360 (GEAP-13837) SEFOR CORE I TRANSIENTS. Noble, L. D.; Kussmaul, G.; Derby, S. L. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Aug 1972. Contract AT(04-3)-540. 171p. AT \$7.60.

The SEFOR Core I transient test program involved the rapid insertion of positive reactivities (produced by ejecting a B_4C rod from a central channel in a time interval of approximately 0.1 sec) ranging between 0.4\$ and 1.3\$. The tests were initiated from power levels between 1 MW and 10 MW. The larger super-prompt critical transients resulted in peak power levels of 9000 MW, and fuel temperature rises 500°F. The super-prompt critical transients demonstrated the prompt power turn around and transient energy limiting capability of the Doppler coefficient during rapid power excursions. Analyses and comparisons of all the transient test data with calculations demonstrated that the reactor transient behavior was both reproducible and predictable. The value of the Core I Doppler coefficient Tdk/dT determined from the transient tests was –0.0081, in good agreement with a power ascension test value of –0.0079, and a calculated value of –0.0085. (auth)

7361 (HEDL-TME-72-106) FAST FLUX TEST FACILITY COUPON SURVEILLANCE PROGRAM. Moen, R. A. (ed.) (Hanford Engineering Development Lab., Richland, Wash.). Dec 1972. Contract AT(45-1)-2170. 103p. Dep. NTIS.

The FFTF Surveillance and In-Service Inspection (SISI) program is explained. SISI is maintained for early detection of abnormal or unexpected behavior and verification of expected behavior of critical components for continued safe and reliable operation of the FFTF and as a basis for establishing a similar program for future LMFBRs. Periodically coupons representing permanently attached components such as vessels; intermediate life replaceable components like reflectors, radial shields, and core baskets; and short-lifetime components like driver fuel elements and control-rod assemblies will be tested. (FS)

7362 (HEDL-TME-73-18) DEVELOPMENT OF SODIUM VAPOR TRAPS FOR FFTF COVER GAS SAMPLING LINES. Part I. Analytical and Laboratory Studies Resulting in the Controlled Cooling Profile Design. Barton, G. B. (Hanford Engineering Development Lab., Richland, Wash.). Feb 1973. Contract AT(45-1)-2170. 38p. AT \$4.00.

Mist removal appears to be the limiting factor in the performance of most existing sodium vapor trap designs. A trap design based on the principle of controlled cooling to prevent mist formation has been developed and tested on a laboratory model. The model proved highly efficient, reducing sodium concentrations in the trap exit gas to 0.02 ppM. (auth)

7363 (HEDL-TME-73-21) THERMAL MIXING IN FFTF SECONDARY PIPING TEES. Creer, J. M.; Watt, J. A.; Yatabe, J. M. (Hanford Engineering Development Lab., Richland, Wash.). Jan 1973. Contract AT(45-1)-2170. 93p. AT \$5.45.

Malfunctions in secondary loop dump heat exchangers could occur in the Fast Flux Test Facility. Such malfunctions would cause sodium streams differing in temperature by as much as 410°F to be mixed in downstream piping tees. An experimental investigation was performed to determine coolant temperature histories near the inside wall of tees at simulated advanced core and rated core operating conditions. The investigation was conducted using a geometric quarter scale model of typical secondary tees. Hot and cold water were used to simulate the sodium coolant. Temperature histories were measured with an array of 50 fast response thermocouples mounted through the wall of the tee and into the coolant stream. Results of the investigation indicate that maximum coolant peak-to-peak temperature fluctuation magnitudes near 94 percent of the temperature difference between the opposing inlet flows can be expected. Periods of coolant temperature oscillations in secondary tees will range to 2.5 seconds. A simplified wall thermal analysis predicted that reactor peak-to-peak coolant temperature fluctuations of 336°F in 0.7 seconds will cause temperature fluctuations as high as 125°F in 1.3 seconds to occur 20% of the distance into the reactor tee wall. (auth)

7364 (ORNL-TM-4176) ORNL TSF PIPE CHASE NEUTRON STREAMING EXPERIMENT: PHASE ONE. McGregor, B. J.; Mynatt, F. R.; Muckenthaler, F. J.; Clifford, C. E. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 73p. AT \$5.45.

Measurements were made at the Tower Shielding Facility of the transmitted neutron intensities behind three configurations of a pipe chase mockup oriented at an angle of 60° from the axis of a neutron beam. The three configurations considered included (1) an empty pipe chase, (2) the pipe chase containing a 16-in. diameter sodium-filled pipe, and (3) the sodium-filled pipe surrounded by insulation. Experimental results obtained included traverses with the Bonner balls just beyond the pipe exit and along the axis of the empty pipe chase configuration. The Benjamin spectrometer measurements were made at three positions 2 ft beyond the pipe chase. A discrete ordinate transport code (DOT III) was used to calculate neutron transport through the duct configurations using a 50-group cross-section library presently being used at ORNL for FFTF shielding analysis. Good agreement between the measurements and calculations was obtained for all three configurations except for the detectors that were sensitive to the lower neutron energies, where the calculations are lower than experiment. These differences apparently indicate that a lower energy cutoff is required for the group structure. The calculated neutron energy spectrum is in good agreement with the measured spectrum covering an energy range from 50 keV to 1.5 MeV. (auth)

7365 (SLA-73-5152) RECENT DEVELOPMENTS IN STRESS ANALYSIS TECHNIQUES FOR FAST BURST REACTORS. Reuscher, J. A. (Sandia Labs., Albuquerque, N. Mex.). 1972. 14p. (CONF-730212-2). Dep. NTIS $3.00.

From fast pulsed reactor symposium; White Sands Missile Range, New Mexico, USA (20 Feb 1973).

Calculational procedures for the stress analysis of fast burst reactors are described, and results are given for elastic, elastic-plastic, and elastic-viscoplastic behavior. These techniques can also include temperature dependent properties. The inclusion of realistic material behavior in the stress analysis results in more accurate calculations of the displacements and stresses in a fast burst reactor core. (auth)

7366 (SLA-73-5156) MODERATOR EFFECTS WITH THE SANDIA PULSED REACTOR II. Reuscher, J. A.; Schmidt, T. R. (Sandia Labs., Albuquerque, N. Mex.). 1973. 14p. (CONF-730212-3). Dep. NTIS $3.00.

From fast pulsed reactor symposium; Alamogordo, New Mexico, USA (20 Feb 1973).

A series of experiments and calculations were performed to investigate the effects of a moderator in the irradiation cavity or near the outer surface of the Sandia Pulsed Reactor II. The reactivity worth and the fission density distribution in the reactor core were examined. The use of a decoupling material such as cadmium or boron-10 was shown to be effective in reducing effects of a moderator in or near the reactor. (auth)

7367 EBR-II FEEDBACK TRANSFER FUNCTION COMPARISON FOR ROD-DROP AND ROD-OSCILLATOR EXPERIMENTS. Larson, H. A.; Engen, I. A. (Argonne National Lab., Idaho Falls, ID). Nucl. Technol.; 18: No. 2, 194-197(May 1973).

Investigation of the dynamic character of EBR-II has been done with rod-drop and rotary rod-oscillator experiments. Both of these experiments provide linear feedback transfer functions in the complex domain; the rod-oscillator experiment gives this information directly, whereas modeling procedures must be done for the rod-drop experiment. Comparisons of results show good qualitative agreement. Quantitatively, the rod-drop experiment appears to predict less feedback than the rod-oscillator experiment. (auth)

7368 MONTE CARLO METHOD OF CALCULATIONS FOR A FAST CRITICAL FACILITY OF A PULSED FAST REACTOR. Navalkar, M. P.; Joneja, O. P.; Subbukutty, K.; Iyengar, S. B. D. (Bhabha Atomic Research Centre, Bombay). pp 763-768 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

A multi-group, multi-zone Monte-Carlo method of calculations has been developed in connection with the study of physics parameters and neutronic behavior for the fast critical facility at Trombay. It has been tested by using known geometries with conventional methods wherever possible. It has been used to estimate the critical mass, both by static and dynamic methods, K_{eff} and reciprocal counts as a function of loading for start-up experiments, worth of various reflectors, leakage spectrum of source neutrons etc. for the critical facility. It is being adapted to the asymmetrical geometry of the pulsed fast reactor. (5 references) (auth)

7369 APPLICATION OF KALMAN FILTERING TECHNIQUE TO NUCLEAR REACTORS. Godbole, S. S. (Babcock and Wilcox Co., Lynchburg, VA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 661-667(Feb 1973).

The application of Kalman filter is presented for estimating the non-measurable variables of a nuclear pool-type research reactor using noisy measurements of only a few variables. The estimated variables are used to identify two parameters of the reactor dynamics. These estimates are also useful for reactor control, protection, instrumentation, operator information, etc. The filtering technique can be applied to more complex nuclear steam systems. (4 references) (auth)

7370 DESIGN AND CONSTRUCTION OF A FAST REACTOR NEUTRON SPECTRUM GENERATOR: NISUS. Besant, C. B. (Imperial Coll. of Science and Tech., London); Emmett, J.; Campbell, C. G.; Kerridge, M.; Jones, T. Nucl. Eng. Int.; 18: No. 204, 425-428(May 1973).

A fast neutron source standard is described which is inexpensive and capable of being adopted as an international standard. The basic requirements of such a standard source are discussed and a description is given of a facility, the Neutron Immediate Standard Uranium Source, designed and built at Imperial College. It is a shell configuration, the outer shell being natural uranium and the inner shell boron carbide. The shells are supported in the center of an air filled spherical cavity hollowed out in a 60 cm cube of graphite. The graphite is mounted in the thermal column by the Consort 2 reactor. The mechanism, design specifications, construction and initial use of the facility, NISUS, are described. (UK)

Production and Materials Testing and Processing Reactors

Refer also to abstracts 7292 and 7293.

7371 (ORNL-4856) IRRADIATION BEHAVIOR OF ALUMINUM BASE FUEL DISPERSIONS. Martin, M. M.; Richt, A. E.; Martin, W. R. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 65p. Dep. NTIS $3.00.

Miniature fuel plates were irradiated to fission densities to greater than 1.8×10^{21} fissions/cm^3 to determine factors that may influence the performance of aluminum-clad aluminium-base UAl$_x$ and U$_3$O$_8$ dispersions in the Advanced Test Reactor (ATR) and the High Flux Isotope Reactor (HFIR). The experiment consisted of 18 uninstrumented single-core test plates and 3 instrumented double-core plates irradiated in the permanent beryllium reflector region of HFIR for 11,613 MWd. The principal experimental variables were initial void content of the fuel dispersions as affected by the type of fuel dispersoid, dispersoid concentration, fabrication procedure, and the fuel dispersoid particle size. Two grades of U$_3$O$_8$, burned and high fired, and arc-cast UAl$_x$ were used at dispersoid concentrations that corresponded to current HFIR and ATR loadings and 25% increases in these loadings. Postirradiation examination of the test fuel plates showed all to be in excellent condition, without evidence of either actual or incipient failure. Maximal fuel core swelling of 8.8 vol % occurred in a UAl$_x$-bearing plate irradiated to a ^{235}U burnup of 1.8×10^{21} fissions/cm^3 at 63 to 80°C. The swelling behavior of the aluminum-clad U$_3$O$_8$-Al and UAl$_x$-Al dispersions, however, depended primarily upon the fission density and the void contents of their cores during irradiation; it was independent of the fuel dispersoid size distribution of less than 44 μm particles. Variations in fuel dispersoid concentration and fuel plate fabrication procedures can alter the void content of these dispersions and affect their irradiation-induced swelling behavior. A mathematical model considering final fission density and initial void content predicts the degree of final plate swelling adequately for most engineering applications. (auth)

Propulsion and Package Reactors

Refer also to abstracts 5503, 7279, and 7616.

7372 (AI-AEC-13058) PERFORMANCE MODELING OF THE 5-KW(e) REACTOR THERMOELECTRIC SYSTEM. Anderson, R. V. (Atomics International, Canoga Park, Calif.). 3 Apr 1973. Contract AT(04-3)-701. 76p. Dep. NTIS $3.00.

A time dependent model has been developed for the 5-KW(e) Reactor Thermoelectric (TE) System. This model incorporates bulk simulation of the TE modules and pump/piping system, with nodal modeling of the radiator subsystem. Temperature dependent degradation of the power and pump TE modules is provided for time dependent performance characteristics. The model is fully parametric and all pertinent variables may be externally controlled. The model may be used for system design specification and system performance mapping analyses. Assumptions incorporated into the model are discussed. (auth)

7373 (GKSS-72-E-17) SYMPOSIUM ON NUCLEAR SHIPS ON MAY 31, 1972, IN RIO DE JANEIRO. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m. b. H., Geesthacht (West Germany); Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). 1972. 106p. (CONF-720583-).

Separate abstracts are included for each of the five papers presented on nuclear merchant ships. (DCC)

For abstracts of individual papers see: 7374-7378.

7374 (GKSS-72-E-17 (Paper 1), pp vp) ECONOMICS OF NUCLEAR MERCHANT SHIPS. Schroeder, E. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m. b. H., Geesthacht, Ger.). 1972.

A comparison of economics is presented for merchant vessels with nuclear and conventional propulsion. Design parameters of a typical nuclear powered container ship are described. A description of the pressurized water reactor used for ship propulsion is presented. Construction costs and transportation costs for nuclear merchant vessels are listed. (DCC)

7375 (GKSS-72-E-17(Paper 2), pp vp) TECHNICAL OPERATION EXPERIENCES OF THE N. S. OTTO HAHN AND PROBLEMS OF PORT ENTRY. Ulken, D.; Bianchi, H.; Kuehl, H. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m. b. H., Geesthacht, Ger.). 1972.

A review of the operations aspects and maintenance requirements for the nuclear ship "Otto Hahn" is presented. Problems related to the port entry for the nuclear ship are discussed. Physics parameters for the reactor under various operating phases of the ship are presented. Radiation doses to ship personnel during 1971 are recorded. (DCC)

7376 (GKSS-72-E-17(Paper 3), pp vp) PERFORMANCE OF THE 1. CORE OF THE OTTO HAHN. Kolb, M.; Schumacher, W. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m. b. H., Geesthacht, Ger.). 1972.

Physics measurements are presented concerning the performance of the nuclear ship "Otto Hahn" first core during 1968 to 1972. (DCC)

7377 (GKSS-72-E-17(Paper 4), pp vp) CORE DESIGN OF THE FDR AND EFDR. Buenemann, D.; Richter, G.; Siewers, H. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m. b. H., Geesthacht, Ger.). 1972.

Design parameters and physics measurements for the cores of the FDR and EFDR reactors for ship propulsion are presented. (DCC)

7378 (GKSS-72-E-17(Paper 5), pp vp) INTEGRATED PRESSURIZED WATER REACTORS AS ENERGY SOURCES FOR VARIOUS PURPOSES. Hedemann, H. J. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m. b. H., Geesthacht, Ger.); Buenemann, D.; Andler, M. 1972.

Design parameters and physics measurements are presented for pressurized-water reactors which can be used for ship propulsion, electric power generation, and process heat applications. (DCC)

7379 (GULF-GA-A-12251) DEVELOPMENT OF A THERMIONIC REACTOR SPACE POWER SYSTEM. Summary Report for Period March 1–June 30, 1972. (Gulf General Atomic Co., San Diego, Calif.). 5 Jan 1973. Contract AT(04-3)-840. 302p. Dep. NTIS $3.00.

The fabrication and performance of UC and UO_2 thermionic fuel elements are described. Physics calculations and design parameters for the reference design electric propulsion reactor are presented. (DCC)

7380 (GULF-GA-A-12419) UNDERSEA THERMIONIC REACTORS. Allen, D. T.; Carney, H. C.; Fisher, C. R.; Heissér, D. J.; Homeyer, W. G.; Leech, W. D.; Marshall, A. C.; Merrill, M. H.; Steeger, E. J. (Gulf General Atomic Co., San Diego, Calif.). 13 Feb 1973. Contract-AT(04-3)-840. 124p. Dep. NTIS $5.45.

Two reactor power systems designed for undersea application are described. Each reactor incorporates incore thermionic fuel elements (TFEs) for the direct conversion of fission heat to electricity. The fuel elements are similar in design to those being developed and tested for application to space nuclear power plants. The remainder of the reactor core in each design is composed of TRIGA type U-ZrH fuel elements. Both cores are water cooled. The first of the two conceptual designs is a compact, lightweight plant called NEMO. It is rated at 30 kW(e) output and is cooled by forced convection. The power plant is intended for manned application with periodic maintenance. The second reactor power system design is the Thermionic Reactor for Installed Oceanic Service (TRIOS) which is intended for unattended power generation of 5 kW(e) net for 10,000 hours without maintenance. This reactor is an extension of the TRIGA pool-type design to undersea operation on the ocean floor. (auth)

7381 (GULF-GA-C-12308) THERMIONIC REACTOR POWER SYSTEM DEVELOPMENT. Volume IV. Reactor Plan. (Gulf General Atomic Co., San Diego, Calif.). 13 Mar 1973. Contract AT(04-3)-840. 57p. Dep. NTIS $5.00.

The thermionic reactor is based on application of a thermionic reactor power system to nuclear electric propulsion (NEP) missions. The plan includes all development activities: design, analysis, experimental engineering, fabrication development, manufacturing, and testing for each reactor in the development program. Scheduling of reactor development activities is based on an overall program plan leading to production of a flight reactor for 1983 launch. This schedule is based on a study performed to provide technical and cost data to the Advanced Propulsion Comparison Committee of NASA to be used as part of an evaluation of propulsion concepts for future interplanetary exploration. The "reactor" includes: fuel elements, vessel, internals, reflectors, control drives, bus bars, reactor auxiliaries, and the control and instrumentation subsystem. The reactor auxiliaries include cesium supply and fission product management subsystems. The control and instrumentation subsystem includes subsystems for: nuclear instrumentation, cesium pressure control, drum drive power, malfunction detection, and electrical output and miscellaneous monitoring instrumentation. (auth)

7382 (N-72-33653) IN-PILE AND OUT-OF-PILE TESTING OF A MOLYBDENUM–URANIUM DIOXIDE CERMET FUELED THERMIONIC DIODE. Dilanni, D. C. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Jan 1972. 57p. (NASA-TM-X-2451). NTIS.

The behavior of $Mo-UO_2$ cermet fuel in a diode for thermionic reactor application was studied. The diode had a Mo–0.5 Ti emitter and niobium collector. Output power ranged from 1.4 to 2.8 W/cm^2 at emitter and collector temperatures of 1500 and 540°C. Thermionic performance was stable within the limits of the instrumentation sensitivity. Through 1000 hours of in-pile operation the emitter was dimensionally stable. However, some fission gases (15 percent) leaked through an inner clad imperfection that occurred during fuel fabrication. (auth)

7383 (N-73-12693) NUCLEAR LIGHT BULB PROPELLANT HEATING SIMULATION USING A TUNGSTEN/ARGON AEROSOL AND RADIATION FROM A DC ARC SURROUNDED BY A SEGMENTED MIRROR CAVITY. Klein, J. F. (United Aircraft Corp., East Hartford, Conn. Research Labs.). Sep 1972. Contract SNPC-70. 57p. (NASA-CR-129499; L-910900-13). NTIS.

Experiments were conducted to simulate radiant heating of the propellant stream of a nuclear light bulb engine to obtain high bulk exit temperatures in the flowing simulated propellant stream by absorption of large fractions of the incident thermal radiation. A high-power, vortex-stabilized dc arc within an uncooled fused silica tube was used as the radiant energy source. It was surrounded by a mirror system to increase the radiation incident on the simulated propellant. The 12.7-cm-long by 2.3-cm-wide, diverging-duct test section had a transparent front wall and a reflecting rear wall. The central stream of seeded gas, a tungsten-particle/argon aerosol, had unseeded argon buffer layers on both sides to prevent coating of the duct walls. Arc operating times were approximately 0.5 sec with power levels up to 780 kW. Bulk exit temperatures were measured using a calorimeter downstream of the duct. The maximum simulated propellant bulk exit temperature obtained was 4515 K, compared with 3860 K in previous tests, 3300 to 3700 K expected in in-reactor tests in the Nuclear Furnace, and 6660 K in the reference nuclear light bulb engine. The maximum temperature in these tests was limited primarily by the amount of radiation incident on the test section (determined by the arc operating characteristics and the effectiveness of the mirror cavity). (auth)

7384 (N-73-12695) CONCEPTUAL DESIGN STUDIES AND EXPERIMENTS RELATED TO CAVITY EXHAUST SYSTEMS FOR NUCLEAR LIGHT BULB CONFIGURATIONS. Kendall, J. S.; Stoeffler, R. C. (United Aircraft Corp., East Hartford, Conn. Research Labs.). Sep 1972. Contract SNPC-70. 33p. (NASA-CR-129298; L-910900-15). NTIS.

Investigations of various phases of gaseous nuclear rocket technology have been conducted. The principal research efforts have recently been directed toward the closed-cycle, vortex-stabilized nuclear light bulb engine and toward a small-scale fissioning uranium plasma experiment that could be conducted in the Los Alamos Scientific Laboratory's Nuclear Furnace. The engine concept is based on the transfer of energy by thermal radiation from gaseous fissioning uranium, through a transparent wall, to hydrogen propellant. The reference engine configuration is comprised of seven unit cavities, each having its own fuel transparent wall and propellant duct. The basic design of the engine is described. Subsequent studies performed to supplement and investigate the basic design are reported. Summaries of other nuclear light bulb research programs are included. (auth)

7385 (N-73-12696) ANALYTICAL DESIGN AND PERFORMANCE STUDIES OF THE NUCLEAR LIGHT BULB ENGINE. Rodgers, R. J.; Latham, T. S. (United Aircraft Corp., East Hartford, Conn. Research Labs.). Sep 1972. Contract SNPC-70. 73p. (NASA-CR-129295; L-910900-16). NTIS.

Analytical studies were conducted to investigate in detail the heat balance characteristics of the nuclear light bulb engine. Distributions of energy deposition to all engine components from the fission process, conduction and convection, and thermal radiation were considered. Where uncertainties in basic data or heat transfer characteristics were encountered, ranges of heat loads were calculated and reference values were selected. The influence of these heat loads on engine performance, space radiator requirements, and cooling sequence and cooling circuit designs was determined. The analyses resulted in revisions to the previously reported reference engine characteristics, principally in the heat loads to some engine components and in the cooling sequence. These revisions were incorporated in the engine dynamics digital computer simulation program. No significant changes occurred in the dynamic response of the engine to perturbations in fuel injection rate, reactivity or exhaust nozzle area. (auth)

7386 (NAA-SR-6395) PROGRESS REPORT FOR SNAP SUPPORTING R AND D, DECEMBER 1960—March 1961. Davis, M. V. (Atomics International, Canoga Park, Calif.). 15 Jun 1961. Contract AT(11-1)-GEN-8. 22p. Dep. NTIS $3.25.

Declassified 17 Apr 1973.

7387 (NAA-SR-7492) SNAP 8 QUARTERLY PROGRESS REPORT, APRIL—JUNE 1962. (Atomics International, Canoga Park, Calif.). 1 Mar 1963. Contract AT(11-1)-GEN-8. 123p. Dep. NTIS $8.25.

Declassified 17 Apr 1973.

Progress is reported for the SNAP 8 reactor development program including objectives, design description, analysis, components, fuel, shield, and system tests. Production yield for finished acceptable fuel elements has increased. Design has been initiated on the developmental reactor mockup (S8DRM-1). Studies have led to modifications in the flight reactor reference design which should result in greater core strength and greater resistance to vibration damage. (auth)

7388 (NAA-SR-7494) SNAP 2/10A REACTOR QUARTERLY PROGRESS REPORT, APRIL—JUNE 1962. (Atomics International, Canoga Park, Calif.) 5 Feb 1963. Contract AT(11-1)-GEN-8. 74p. Dep. NTIS $5.75.

Declassified 17 Apr 1973.

Research progress in the SNAP 2/10A reactor program is reported. The research covers reactor system development, fuel development, and component development. (JWR)

7389 (NAA-SR-7792(Vol.1)) SNAP 8 QUARTERLY PROGRESS REPORT, JULY—SEPTEMBER 1962. Vol. I. Reactor Engineering and System Tests. Johnson, C. H. (ed.) (Atomics International, Canoga Park, Calif.). 22 Apr 1963. Contract AT(11-1)-GEN-8. 216p. Dep. NTIS $13.00.

Declassified 3 May 1973.

Progress in the development of the SNAP 8 reactor, including its associated controls, shields, and safety features, is reported. Results from the test programs for the reactor and associated power conversion equipment are also described. (JWR)

7390 (NAA-SR-9400(Vol.3)) LITHIUM HYDRIDE TECHNOLOGY. III. Properties of Lithium Hydride for SNAP Shielding Applications. Welch, F. H. (Atomics International, Canoga Park, Calif.). 1 May 1967. AT(04-3)-701. 114p. Dep. NTIS $7.75.

Declassified 3 May 1973.

The physico-chemical and mechanical properties, the corrosivity, and the radiation damage characteristics of lithium hydride are described covering the work performed from 1964 through 1966 which was funded by the SNAP General Supporting Technology Program. New data is presented from laboratory studies on LiH such as hydrogen migration in LiH, the effect of LiH on the diffusion of hydrogen through stainless steel, the rate of hydriding of metallic lithium, and many other subjects related to SNAP shielding application. The effect of LiH on braze alloys, and SNAP 8 emissive coatings is described. The effects of mixtures of Li and LiH on stainless steel are also described. The recent irradiation tests on LiH and theories to explain the observed behavior are reviewed. A number of postulates are made predicting the types of behavior which should be expected under various irradiation conditions. (auth)

7391 (NAA-SR-9903) SNAP 10A REACTOR THERMAL PERFORMANCE. Magee, P. M.; Dufoe, G. E.; Gordon, J. D. (Atomics International, Canoga Park, Calif.). 1 Sep 1964. Contract AT(11-1)-GEN-8. 48p. Dep. NTIS $4.50.

Declassified 24 May 1973.

The thermal and hydraulic performance of the SNAP 10A reactor is summarized. The anticipated flow distribution and pressure drop are discussed. Nominal steady-state temperature distributions for the core average, edge, and center fuel elements are given. Maximum temperatures within the center fuel element are estimated by considering hot-channel factors, which include the effects of eccentric fuel rods, tricuspid channel geometry, and uncertainties in power and flow distributions. Thermal stresses, associated with the resulting "hot" element temperatures, are investigated. Several startup transients are analyzed; in each case, maximum temperatures and temperature gradients are determined and the resulting stresses investigated. Particular emphasis is placed upon the startup of the flight system in space. The analysis indicates that the SNAP 10A reactor is a conservative thermal design; all temperatures and thermal stresses, during startup and steady-state operation, are well within design limits. (auth)

7392 (NAA-SR-9990) SNAP REACTOR IMPROVEMENT PROGRAM. Progress Report, April—June 1964. Gimera, R. J.; Susnir, J. (Atomics International, Canoga Park, Calif.). 31 Aug 1964. Contract AT(11-1)-Gen-8. 118p. Dep. NTIS $8.00.

Declassified 24 May 1973.

New guidance has been established for the program for FY 1965—1966. Two specific work areas have been chosen and are identified as the Interim SNAP 10A/2 Reactor Project and the SNAP 10B Reactor Project. All other work planned under the program was terminated at the end of FY 1964. The objectives of the Interim SNAP 10A/2 Reactor Project are to complete environmental testing of coated fuel elements fabricated under the SNAP 10A Program, to complete irradiation and analysis of the 82-1 fuel capsule, to complete the testing program for DRM-1, and to prepare a complete package of components and subsystem drawings and specifications for the S2 reactor reflector shield assembly. The Reactor design is based upon objectives of 100 kwt and 1200°F NaK outlet temperature. The FY 1965 objective of the SNAP 10B Reactor Project is preliminary design of an ultra lightweight reactor operating in combination with a thermoelectric power conversion system. The design goals will be operational simplicity and maximum reliability. (auth)

7393 (NAA-SR-10188) DEVELOPMENTAL TESTING SNAP 2 FUEL ELEMENTS. Isaacs, J L. (Atomics International, Canoga Park, Calif.). 1 Dec 1964. Contract AT(11-1)-Gen-8. 24p. Dep. NTIS $3.25.

Declassified 24 May 1973.

Forty-three developmental SNAP 2 fuel elements (normal uranium) were subjected to environmental inputs, in order to obtain a qualitative measure of their performance. Seven fuel elements completed the program, and seven others failed during testing. The testing of the remaining 29 elements was discontinued when the SNAP 2 fuel element development program was redirected. The SNAP 2 fuel elements were found to perform well at 1300°F and under vibration and shock at the component qualification level for SNAP 10A. Generally, the elements were damaged if vibration and shock levels exceeded the component qualification level for SNAP 10A by a factor of two or more. The damage appeared to a direct function of the level of the input. (auth)

7394 (NAA-SR-11097) SNAP AEROSPACE SAFETY PROGRAM. Progress Report, January—March 1965. Detterman, R. L. (Atomics International, Canoga Park, Calif.). 15 May 1965. Contract AT(11-1)-Gen-8. 33p. Dep. NTIS $3.75.

Declassified 24 May 1973.

The effects of NaK on SNAP 10A disintegration are discussed based on thermal analysis of the NaK pipes, pump, and the reactor. The results of a third series of 100-ft drop tests of 7 modified test reactor vessels are summarized in detail. The SNAPTRAN-1 step transient tests were completed and the results are described and analyzed. The findings, to date, of a generalized parameter study of potential design changes in SNAP 10A cores to ensure subcriticality in water are presented. (auth)

7395 (NAA-SR-11361) WATER IMMERSION SAFETY FOR SNAP REACTORS. Hawley, J. P. (Atomics International, Canoga Park, Calif.). 30 Sep 1967. Contract AT(04-3)-701. 49p. Dep. NTIS $4.50.

Declassified 24 May 1973.

Potential radiological hazards associated with the construction, launch, operation, and disposal of SNAP (Systems for Nuclear Auxiliary Power) have been studied. Accidental preorbital criticality and end-of-life disposal are the two most difficult safety problems which were identified. The prevention of accidental criticality is the subject of this report. Water flooding and reflection, which results in increased neutron moderation in a SNAP reactor core, was found to be the most reactive situation which might be accidentally encountered. Two methods are described which assure that the water-flooded and -reflected reactor will be subcritical while retaining the desired excess reactivity when in the operational (NaK-cooled and beryllium-reflected) configuration. The two methods studied were: using highly spectrum-dependent thermal-resonance neutron absorbers on the fuel elements and in the core/reflector interface region and changing of core and reflector geometry. These methods were both effective. It was concluded that using gadolinium as a spectrum-dependent thermal resonance neutron absorber should be further explored and that it should be incorporated in future SNAP reactor designs where subcriticality in water is required. (auth)

7396 (NAA-SR-11492) SNAP 8 PROGRESS REPORT, MAY–JULY 1965. Mason, D. G. (Atomics International, Canoga Park, Calif.). 30 Sep 1965. Contract AT(11-1)-Gen-8. 156p. Dep. NTIS $10.00.

Declassified 24 May 1973.

Progress is reported on the SNAP 8 Nuclear System Program including objectives, design description, system analyses, component development, and system tests. Final assembly of the S8DS reactor was started. S8ER fuel elements were removed from the core vessel using the unitized core removal method. (auth)

7397 (NAA-SR-11497) SNAP AEROSPACE SAFETY PROGRAM. Progress Report, April–June 1965. Detterman, R. L. (Atomics International, Canoga Park, Calif.). 15 Aug 1965. Contract AT(11-1)-Gen-8. 39p. Dep. NTIS $4.00.

Declassified 24 May 1973.

7398 (NAA-SR-11597) MERCURY RANKINE PROGRAM ALTERNATOR BORE SEAL–UNSEALED ALTERNATOR. Horii, H.; Wesolowski, A. I. (Atomics International, Canoga Park, Calif.). 15 Mar 1966. Contract AT(11-1)-Gen-8. 78p. Dep. NTIS $6.00.

Declassified 24 May 1973.

The Mercury Rankine Program utilizes a hermetically sealed Combined Rotating Unit as the basic turboalternator machinery. The liquid mercury used in this unit is incompatible with the alternator stator in two respects: it will dissolve the silver stator windings during even brief exposure, and it will cause electrical continuity (shorting) between windings and to ground. Basically, the resolution to this problem is to exclude mercury from the stator by using a hermetically sealed stator bore containment. The optimum bore sealing materials were the electrically and chemically inert glasses and ceramics. A program was started to investigate the use of coated windings rather than a coated bore. Just prior to completion of the program, the use of an evacuated stator, which tolerated small bore seal leaks and the exposure of silver wires to dry mercury vapor, was conceived. Feasibility of the unsealed stator concept was verified. Efforts to improve leak tightness by stator redesign and utilization of a pyroceramic glaze indicated significant improvement over the previous glass application. (auth)

7399 (NAA-SR-11690) SNAP REACTOR IMPROVEMENT PROGRAM. Progress Report, July–September 1965. Maki, L. M. (Atomics International, Canoga Park, Calif.). 22 Nov 1965. Contract AT(11-1)-Gen-8. 46p. Dep. NTIS $4.50.

Declassified 24 May 1973.

7400 (NAA-SR-11692) SNAP 8 PROGRESS REPORT, AUGUST–OCTOBER 1965. Mason, D. G. (Atomics International, Canoga Park, Calif.). 29 Dec 1965. Contract AT(11-1)-Gen-8. 73p. Dep. NTIS $5.75.

Declassified 24 May 1973.

Progress is reported on the SNAP 8 Nuclear System Program including objectives, design description, system analyses, component development, and system tests. Results on disassembly of the S8ER core and preliminary screening examination of the fuel elements are reported. Acceptance testing of the S8DS components is described. (auth)

7401 (NAA-SR-11696) PROGRESS REPORT FOR SNAP (SYSTEMS FOR NUCLEAR AUXILIARY POWER) GENERAL SUPPORTING TECHNOLOGY, AUGUST–OCTOBER 1965. Mims, L. S. (Atomics International, Canoga Park, Calif.). 15 Jan 1966. Contract AT(11-1)-GEN-8. 34p. Dep. NTIS $3.75.

Declassified 17 Apr 1973.

7402 (NAA-SR-11697) SNAP AEROSPACE SAFETY PROGRAM. Progress Report, July–September 1965. Detterman, R. L. (Atomics International, Canoga Park, Calif.). 15 Nov 1965. Contract AT(11-1)-Gen-8. 42p. Dep. NTIS $4.25.

Declassified 24 May 1973.

7403 (NAA-SR-11756) PROGRESS REPORT FOR SNAP GENERAL SUPPORTING TECHNOLOGY, NOVEMBER 1965–JANUARY 1966. Mims, L. S. (Atomics International, Canoga Park, Calif.). 15 Mar 1966. Contract AT(11-1)-GEN-8. 62p. Dep. NTIS $5.25.

Declassified 17 Apr 1973.

Progress in activities in support of SNAP reactor development is reported. These activities include development of analytical techniques as well as assembly, development, and correlation of theoretical and experimental data necessary for the successful accomplishment of SNAP program objectives. (JWR)

7404 (NAA-SR-11757) SNAP 10A PROGRESS REPORT, October–December 1965. Staub, D. W. (Atomics International, Canoga Park, Calif.). 10 Mar 1966. Contract AT(11-1)-Gen-8. 92p. Dep. NTIS $6.75.

Declassified 24 May 1973.

Possible causes of the premature shutdown of the SNAP 10A system were examined by an extensive analysis and test program. The shutdown occurred 43 days after the SNAP 10AFS-4/Agena spacecraft was launched into a polar orbit from Vandenberg Air Force Base on April 3, 1965. The analysis indicated that the most probable cause of failure was an over-voltage condition on the power bus, beginning with a voltage regulator failure and ending with spurious commands which caused reactor shutdown by ejecting the reflector. Complete results were published in NAA-SR-MEMO-11635. Component testing is continuing with emphasis on endurance testing to qualify the SNAP 10A components in a near-space environment for one year and beyond. The S10FS-3 nuclear ground test system has operated continuously since startup on January 22, 1965 and had completed 343 days of uninterrupted power operation by December 31. System operation has been normal and well within design requirements. The one-year power endurance test is continuing. Significant observations from the S10FS-3 operations to date are: (1) individual component performance from the system closely matches that obtained from individual component tests; (2) the combined effects of temperature-vacuum and nuclear radiation can be adequately simulated on component tests by separate radiation damage tests, at least over the integrated dose levels expected from SNAP 10A; (3) performance degradation of components has been as expected. No catastrophic endurance of environment-induced failures have occurred on such items as emissivity coatings; and (4) system operation is extremely stable. (auth)

7405 (NAA-SR-11882) SNAP REACTOR IMPROVEMENT PROGRAM. Progress Report, January–March 1966. Maki, L. M. (Atomics International, Canoga Park, Calif.). 23 May 1966. Contract AT(11-1)-Gen-8. 113p. Dep. NTIS $7.75.

Declassified 24 May 1973.

7406 (NAA-SR-11950) EXPERIMENTAL INVESTIGATIONS FOR DESIGN OF SUBCRITICAL WATER-IMMERSED SNAP REACTORS. Heneveld, W. H. (Atomics International, Canoga Park, Calif.). 28 Jul 1966. Contract AT(11-1)-Gen-8. 37p. Dep. NTIS $4.00.

Declassified 24 May 1973.

7407 (NAA-SR-12021) SNAP AEROSPACE NUCLEAR SAFETY PROGRAM. Progress Report, April–June 1966. Detterman, R. L. (Atomics International, Canoga Park, Calif.). 15 Aug 1966. Contract AT(11-1)-Gen-8. 67p. Dep. NTIS $5.50.

Declassified 24 May 1973.

7408 (NAA-SR-12300) FUNCTIONAL DESIGN DESCRIPTION AND TEST SUMMARY OF THE SNAP 8 DEVELOPMENT REACTOR MOCKUP 1. Kurzeka, W. J. (ed.) (Atomics International, Canoga Park, Calif.). 24 Feb 1967. AT(04-3)-701. 64p. Dep. NTIS $5.25.

Declassified 3 May 1973.

The design, fabrication, and testing of the SNAP 8 Development Reactor Mockup-1 by Atomics International (AI) is described. The program objectives and design requirements are stated. The components and assembly are shown in photographs and described functionally. Several test phases including shock and vibration testing and operations at high temperature in a vacuum chamber are described. The program met all objectives before termination of the program in July of 1965. (auth)

7409 (NAA-SR-12454) GENERAL SUPPORTING TECHNOLOGY PROGRESS REPORT FOR SNAP, FEBRUARY–APRIL 1967. Mims, L. S. (Atomics International, Canoga Park, Calif.). 20 Jun 1967. AT(04-3)-701. 32p. Dep. NTIS $3.75.

Declassified 3 May 1973.

7410 (NAA-SR-12482) S8DR CORE PERFORMANCE EVALUATION. Swenson, L. D. (Atomics International, Canoga Park, Calif.). 9 Aug 1967. Contract AT(04-3)-701. 74p. Dep. NTIS $5.75.

Declassified 24 May 1973.

The SNAP 8 Developmental Reactor (S8DR)–formerly S8DS–design was reviewed in order to incorporate information from the SNAP 8 Experimental Reactor (S8ER) reactor operation and post-operation examination, information from the recent fuel capsule irradiations, and current information on the hydrogen leakage behavior of the fuel elements. The reactor trade studies associated with the final design specification for S8DR are detailed. The recommendations resulting from the completed study are: increase the axial fuel-to-cladding clearance to 0.240 in.; reduce the fuel rod diameter by 0.001-in.; retain the nominal 10-mil cladding thickness; utilize a new fuel element upper end cap design; modify the fuel element lower end cap design; modify the fuel rod dimensions to accommodate the recommended changes; retain the uniformly spaced, 211 fuel element core concept; increase the minimum element-to-element spacing from 7.4 to 10 mils; machine the core vessel ID to accommodate recommendation on spacing; reduce the system operating pressure to 35 psia; modify the coolant flow profile through the core; and conduct hydraulic tests to verify the design changes. (auth)

7411 (NAA-SR-12564) SNAP 8 DEVELOPMENTAL REACTOR (S8DR) CORE THERMAL AND HYDRAULIC PERFORMANCE. Magee, P. M. (Atomics International, Canoga Park, Calif.). 10 Mar 1968. Contract AT(04-3)-701. 96p. Dep. NTIS $7.00. Declassified 24 May 1973.

The anticipated steady-state thermal and hydraulic performance of the SNAP 8 Developmental Reactor (S8DR) are discussed. The desired core flow distribution is achieved through the use of a distributor ring and an orifice plate mounted below the core. The combined effectiveness of the two devices has been experimentally demonstrated in hydraulic tests using a full-scale reactor model and water as the test fluid. Reactor pressure losses are also listed and discussed. The average thermal performance of the reactor is defined in terms of an overall heat-transfer coefficient (UA). This is presented as a function of temperature for beginning-of-life and end-of-life (12,000-hr) conditions. Detailed core-temperature distributions are presented for the two specified operating levels: 600 kwt 1100°F reactor inlet and 1300°F outlet; and 1 MWt 830°F reactor inlet and 1100°F outlet. The thermal effects of variations in such basic geometric parameters as element spacing, gas-gap width, and fuel-rod centering are discussed. Fuel, cladding, and coolant-temperature uncertainties are derived. The reduction in fuel-temperature uncertainties due to incore measurements of coolant-outlet temperatures is noted. Because it is the final topical report scheduled to be issued before S8DR startup, this report also serves to update calculated performance parameters, principally reactor lifetime limits. (auth)

7412 CURRENT STATUS AND FUTURE PROSPECTS OF NUCLEAR SHIP PROPULSION SYSTEMS. Illies, K. Kerntechnik; 15: No. 3, 114-120(1973). (In German and English).

A comparison of nuclear ship propulsion systems and nuclear power plants is given from the technological and economic point of view. Technically, ship reactors (pressurized water reactors in all cases) have proven to give good service under the rough conditions of ship board. Economically, however, the competition of nuclear ships with conventional ships is difficult to evaluate for several reasons, e.g., capital costs (high specific construction costs), special training of personnel, uncertainty in problems of liability insurance, and costly licensing procedures. The construction of merchant ships with nuclear propulsion should only be considered if the power rating is greater than 100,000 ship hp and if the utilization factor is high. (GE)

7413 OPTIMIZATION OF NUCLEAR REACTOR ENERGY SUPPLY SYSTEMS BY MEANS OF TURBO-ELECTRIC CONVERTERS. Blumenberg, J. (Technische Univ., Munich). Raumfahrtforschung; 17: No. 1, 10-15(1973). (In German).

Recent investigations in the field of reactor design for nuclear-electric space power systems have shown that the mass of the reactor shielding is much higher than supposed in the early sixties. The state of the art shows that the influence of the reactor shielding on the mass-break-down is highly important and may not be neglected in an optimized nuclear space power system. Based upon the classic ¾-equation and Ruppe's optimum theory a mathematical thermal model is described for a turbo-electric nuclear space power system with Rankine cycle. This model leads to exact statements concerning the optimum temperature ratio and the optimum specific mass. The influence of technological parameters and their consequences on the system components—especially the radiator device—are discussed. (GE)

7414 PROPULSION IN SPACE IN THE YEAR 2000. Jaumotte, A. L. (Univ. Libre, Brussels). Bull. Cl. Sci., Acad. Roy. Belg.; 58: No. 6, 692-709(1972). (In French).

7415 NUKLEARE SICHERHEIT VON KERNENERGIESCHIFFEN. (Nuclear Safety of Nuclear Energy Ships). Schafstall, H. KEST Nr. 19. Munich; Verlag Karl Thiemig KG (1970). 92p.

Safety techniques of nuclear reactors are analyzed with special consideration to their application to the propulsion of ships. Results show that safety techniques play a decisive role in the commercial use of nuclear propulsion systems. By means of a described method, the failure probability can be assessed for components as well as for systems. Through this method, a realistic analysis can be performed with respect to the occurrence of disturbances and incidents. (tr-auth)

7416 TIME-OPTIMAL NUCLEAR ROCKET PROPELLANT START-UP WITH THERMAL STRESS CONSTRAINTS BASED ON DISTRIBUTED PARAMETER MODEL. Wittler, M.; Shen, C. N. Automatica; 6: No. 2, 221-229(Mar 1970).

Core and propellant temperatures of a solid fuel element nuclear rocket are described by a pair of coupled partial differential equations depending on the power distribution and the propellant flow rate; the latter is taken as the independent control variable. The thermal stress in the core is given by a product of state and control variables. The set of partial differential equations is solved in integral form for core temperature, propellant temperature, and the difference between them. These integral expressions are used in finding the control program which increases the propellant flow rate from a given steady-state level to a fixed higher level in minimum time without exceeding a certain maximum tolerable stress in the core. This problem is shown to be equivalent to a certain fixed final time problem which requires the minimization of a functional subject to an integral equation and an integro-differential inequality constraint. The optimal conditions for such a problem are not yet available in the literature but are derived and used for obtaining the minimum time control law in closed form. A computer algorithm for the numerical implementation is derived. Numerical results are given for different power distributions. (App. Mech. Rev.)

Reactor Safety and Environmental Aspects

Refer also to abstracts 5512, 5525, 5543, and 7622.

7417 (ANCR-1098) SYNTHETIC TREE MODEL: A FORMAL METHODOLOGY FOR FAULT TREE CONSTRUCTION. Fussell, J. B. (Aerojet Nuclear Co., Idaho Falls, Idaho). Mar 1973. Contract AT(10-1)-1375. 118p. Dep. NTIS $5.45.

Fault tree analysis is a recently developed method of reliability analysis generally applicable to complex, dynamic systems which include nuclear reactor systems. Fault tree analysis offers a tool by which systems may be optimized in design to achieve, within the limits of engineering capabilities, the dual requirements for maximum safety and plant availability and minimum cost and complexity. The influence of the application of formal reliability analysis to all systems will result in higher probability of the systems functioning properly. A formal methodology, Synthetic Tree Model, for constructing fault trees for electrical systems to the point where identifiable primary component failures will directly produce the required fault events is provided. While the model is developed only for electrical systems, its implications extend to all fault tree constructions. Existing fault tree terminology is used in Synthetic Tree Model. The resultant fault trees are in a conventional format and are compatible with presently used fault tree solution techniques. Actually, they differ from a conventionally constructed fault tree in few ways. One difference is that, should any number of analysts construct fault trees independently for a given system and main failure event, using Synthetic Tree Model, they will all obtain identical fault trees. This is not a characteristic of conventional fault tree construction but a model that affords the opportunity to reduce the cost of and time required for a fault tree analysis as well as provides potential for a standard by which fault trees can be constructed or checked. Synthetic Tree Model is a synthesis technique for piecing together, with proper editing, a fault tree from small segments called component failure transfer functions. The component failure transfer functions are obtained from a system-independent failure mode analysis of individual components. This piecing together is an uncomplicated process but does involve "bookkeeping" such that the appropriate editing of the component failure transfer functions can be carried out. The component failure transfer functions are a limiting factor on the resolution of the fault trees resulting from Synthetic Tree Model. While automation of fault tree construction is possible in the framework of Synthetic Tree Model, an experimental computer program, DRAFT, has been written to accomplish this for certain electrical systems; this automation formulates yet another distinct type of analysis. The automated construction has potential as an overall, summary-type analysis that can be routinely done in a relatively small amount of time. Automation of Synthetic Tree Model provides the fault tree analyst a valuable tool to complement his present skills while Synthetic Tree Model itself is immediately applicable to manual fault tree construction with the advantages of this manual analysis. The model is purposely left "open ended" to allow for its extension. Synthetic Tree Model shows potential for becoming a standard for fault tree construction as it is a formal approach to fault tree construction. The technique is of a general enough nature to allow fault tree construction for systems both in the nuclear industry and elsewhere. (auth)

7418 (BAW-10064) MULTINODE ANALYSIS OF CORE FLOODING LINE BREAK FOR B AND W's 2568-MWt INTERNALS VENT VALVE PLANTS. Dunn, B. M.; Morgan, C. D.; Cartin,

L. R. (Babcock and Wilcox Co., Lynchburg, VA (USA). Nuclear Power Generation Div.). Apr 1973. 41p.

The FOAM Computer Code predicts the consequences of a rupture of a core flooding line. An analysis was carried out using the CRAFT Code to evaluate the hydrodynamics and transient water inventories of the reactor coolant system. The FOAM Code was used to compute a swell level history for the core, and the THETA 1-B Code was used to perform transient fuel pin heatup calculations. The FOAM data are in good agreement with data from tests conducted by General Electric, Hitachi, and Westinghouse and confirm the applicability of the code to reactor analysis. (auth)

7419 (CENPD-83(Rev. 1)) DESCRIPTION OF METHODOLOGY FOR DEVELOPING MASS/ENERGY RELEASE DATA FOR CONTAINMENT DESIGN. (Combustion Engineering, Inc., Windsor, Conn. Nuclear Power Dept.). Apr 1973. 154p. Dep. NTIS $9.75.

The WALLSOB computer model used to generate the mass/energy release data for sizing the containment buildup is described. The WALLSOB methodology is biased towards removing energy from the reactor cooling system during the blowdown phase of a LOCA to maximize the containment design pressure. Sample calculations for a 3410 MW(t) plant are presented. (JWR)

7420 (CENPD-87(Rev. 1)) SAFETY RELATED RESEARCH AND DEVELOPMENT FOR COMBUSTION ENGINEERING PRESSURIZED WATER REACTORS. Program Summaries. Spinell, A. B. Jr. (comp.) (Combustion Engineering, Inc., Windsor, Conn. Nuclear Power Dept). Mar 1973. 83p.

Descriptions of safety related programs applicable to C-E pressurized water reactors are presented. Technical information generated by these R + D programs is used to either demonstrate the safety of the design, define margins of conservatism, insure adequacy of design, or lead to design improvements. (FS)

7421 (CONF-721202-18) EFFLUENT MONITORING IN NUCLEAR PLANTS USING ON-LINE GAMMA-RAY SPECTROMETRY. Heath, R. L.; Cline, J. E. (Aerojet Nuclear Co., Idaho Falls, Idaho). [nd]. 15p. Dep. NTIS $3.00.

From nuclear science symposium; Miami Beach, Florida, USA (6 Dec 1972).

The operation of large nuclear power plants involves significant inventories of radioactive fission product isotopes. Effective monitoring of effluent streams from nuclear facilities requires the characterization of radioactivity present in operating systems to permit evaluation of potential hazards which might result from discharge of any radioactivity to the environment. The need for adequate documentation and control of effluents establishes a requirement for realtime determination of radioactivity on an isotopic basis. An outline of the application of high-resolution gamma-ray spectrometry to this problem is given. To meet the requirement for a practical working system it has been necessary to develop a completely automated gamma-ray spectrometer concept incorporating a remote computer operated pulse-height analyzer, calibration and data analysis techniques. An operating system is described which utilizes a PDP-9 data system to operate a number of on-line spectrometers, providing automated data analysis and report generation. A detailed description of the techniques and hardware developed for this purpose is presented. (auth)

7422 (CONF-730427-1) EXPLORATORY MODEL STUDIES OF REACTOR PLATFORM MOTIONS. I. Unprotected Deep Water Sites. Thomas, D. G.; Sheppard, J. D.; Hammond, R. P. (Oak Ridge National Lab., Tenn). 1973. 4p. Dep. NTIS $3.00.

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973).

Exploratory studies of the motion of small-scale reactor platform models in scaled water depths are reported. Heave, roll, and pitch with gravity as the restoring force and surge, sway, and yaw with the restoring force being the cable weight, were evaluated. All motions were observed except sway and roll. Of the observed motions, pitching produces the largest accelerations and would have the most adverse effect on dynamically balanced system components. (FS)

7423 (EURFNR-1083) KINTIC-1: A PROGRAM FOR THE CALCULATION OF TWO-DIMENSIONAL REACTOR DYNAMICS OF FAST REACTORS WITH THE QUASISTATIC METHOD. Mayer, L.; Bachmann, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Nov 1972. 114p. (KFK-1627). Dep. NTIS (U. S. Sales Only) $5.45.

Work performed under United States-Euratom Fast Reactor Exchange Program.

KINTIC-1 is the first version of a system of programs for treating all stages of a reactor excursion, starting with the initial perturbation and finishing, eventually, with core disassembly and a second excursion. A summary of the basic physical models underlying the program is given. It has been developed for two-dimensional geometry, using the quasistatic method for the neutron kinetics part. Currently, only external perturbations caused by some sort of material movement can be simulated. For the description of zone dependent thermodynamics in the core and blanket, a model with a single representative channel for each different reactor zone is employed. Feedback effects include space dependent density changes and expansion of reactor zones and cross section changes due to the Doppler effect. At present, coolant boiling, interaction of sodium and fuel etc. are not included. The parameters of a problem (e.g. number of mesh points, of energy groups etc.) may be chosen freely within the limits of the available computer storage, since dynamic storage assignment has been used. Additionally, limits have been imposed on the number of energy groups (26), precursor groups (6), reactor material zones (100) and representative coolant channels (10). A short discussion of future extensions of KINTIC and some numerical calculations and comparisons are presented. Input and control card lists, a small sample case, and some information on program organization and flow charts are also included. (auth)

7424 (GEAP-10207-28) REACTOR PRIMARY COOLANT SYSTEM PIPE RUPTURE STUDY. Progress Report No. 28, July-December 1972. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.) Feb 1973. Contract AT(04-3)-189. 88p. Dep. NTIS $5.45.

The pipe rupture study is designed to extend the understanding of failure-causing mechanisms and to provide improved capability for evaluating reactor piping systems to minimize the probability of failures. Following a detailed review to determine the effort most needed to improve nuclear system piping, analytical and experimental efforts were started in 1965. The recent accomplishments are summarized of a broad program in (a) fatigue studies through both bench-scale and large-component tests, (b) at-reactor tests of the effect of primary coolant environment on the fatigue behavior of piping steels, and (c) failure probability study of actual reactor piping systems. (auth)

7425 (GEAP-10763) LOW CYCLE FATIGUE OF PROTOTYPE PIPE COMPONENTS. Heald, J. D.; Kiss, E. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Jan 1973. Contract AT(04-3)-189. 40p. Dep. NTIS $4.00.

The results of low cycle fatigue testing and ASME Boiler and Pressure Vessel Code, Section III analysis of 28 prototype piping components are described. In addition, updated Section III analysis is included for the 32 notched prototype pipe specimens previously reported. The pipe components and weld specimens were fabricated from Type-304 stainless steel and A106B carbon steel and are identical to those used for the primary piping of lightwater nuclear reactors. Specimens included 6-in., schedule 40 and 80 elbows, tees and girth butt-welded straight sections. Fatigue testing consisted primarily of subjecting the specimens to deflection-controlled, cyclic bending with cyclic load monitored. Thus, these tests simulate thermal expansion type loading. Tests were conducted at room temperature and 550°F. At room temperature the specimens were subjected to 1050 psi constant internal pressure. In two tests at room temperature, however, stainless steel elbows were subjected to combined simultaneous cyclic internal pressure and cyclic bending. Predictions of the fatigue life of each of the specimens tested have been made according to the procedures specified in Section III, "Nuclear Power Plant Components," in order to assess the code design safety factor. For the purpose of the assessment, fatigue life has been defined as the number of significant fatigue cycles to produce complete through-wall crack growth (leakage). For some tests, however, ultrasonic inspection was performed periodically to determine when cracking had occurred. In the cases where ultrasonic data are available, a comparison of cycles to "initiation" and "leakage" is made. (auth)

7426 (LIB/Trans-453) FRACTURE DANGER IN REACTOR PRESSURE VESSELS AND PIPING. Wellinger, K.; Kraegeloh, E.; Kussmaul, K.; Sturm, D. Translated by K. Cecers from Nucl. Eng. Des.; 20: 215-235(1972). 27p. (CONF-710903-33). Dep. NTIS (U. S. Sales Only) $3.50.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

By proper material selection, design and analysis, together with the applicable material testing methods, bursting of pressure-vessels and pipings may be excluded, even if the components contain material defects to a certain degree. The methods of strength calculation applied are based on the ability of the material to withstand plastic deformation, which therefore must be guaranteed under all service conditions and possible states of the material. Some unanswered questions in the field of safety-analysis are examined. Some of these concern embrittlement phenomena caused by unfavorable states of stress—i.e., with multi-axial residual tensile stresses, so far not considered in fracture mechanics—furthermore the effective material properties in the finished structural component (basic material, welded joints with local embrittlement and/or stress-relief embrittlement) including the influence of service conditions and the question of the allowable maximum nominal stress. In the case of seamless and normalized or quenched and tempered uncomplicated structure members, there exist relatively simple relationships between specimens or models and the real component. This is generally not true for thick-walled and/or welded structures even if the latter are stress relief heat-treated. Such structures may collapse at nominal stresses far below the yield stress, as soon as a critical value of the residual stresses is exceeded if simultaneously unfavorable material conditions exist. These statements are based on tests with unnotched and notched plates, pipes and pressure vessels with liquid and gaseous pressure media under static or repeated loading, and on the analysis of damaged components. (auth)

7427 (RD/B/N-1729) METAL COOLANT THERMAL INTERACTIONS AT HIGH TEMPERATURES: A STUDY OF THE TRANSIENT ENERGY TRANSFER PROCESSES. Board, S. J.; Clare, A. J.; Duffey, R. B.; Hall, R. S.; Poole, D. H. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs). Jun 1970. 35p. Dep. NTIS (U. S. Sales Only) $3.75.

The energy transfer and vapor production processes relevant to a thermal explosion have been studied in an experiment involving the transient heating of a metal foil under water. Measurements with response times ≤ 10 μs were made of temperature, pressure and heat flux over the range of foil temperatures 100-900°C and water subcoolings 20-80°C. Both unstable and stable energy transfer processes have been shown to occur at temperatures above the nucleate boiling region and relevant quantitative heat flux data have been obtained. (auth)

7428 (STI/PUB-321(Rev.)) NUCLEAR POWER AND THE ENVIRONMENT. (International Atomic Energy Agency, Vienna (Austria)). Jan 1973. 95p. IAEA $2.00.

The effects of nuclear power on environmental changes are discussed including changes due to plant construction, transmission lines, and thermal discharges. Radiation protection standards for nuclear power plants and safe handling procedures for uranium milling, mining, enrichment, fuel fabrication, fuel reprocessing, fuel transportation, and waste management are reviewed. Operational diagrams of different types of generating stations and waste systems are given. (FS)

7429 (UNC-5163) CONTAINMENT PRESSURE OF ELK RIVER REACTOR WITH ZIRCALOY-CLAD CORE FOLLOWING A LOSS-OF-COOLANT ACCIDENT. Cooper, M. H.; Hankel, R. D.; Teer, B. R. (United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center). 15 Dec 1966. Contract AT(11-1)-1648. 106p. Dep. NTIS $7.50.

A possible replacement fuel design for the Elk River Reactor is a 164 fuel element Zircaloy clad core operating at a power of 116 Mw(t). An analysis of the containment pressure and temperature following a loss-of-coolant accident has been made for this plant. The maximum pressure reached at the end of the initial blowdown is 20.9 psig which is less than the design pressure of 21.0 psig and the test pressure of 26.25 psig. The pressure after the initial blowdown decreases for several hours because heat removal by conduction in the heat sinks is greater than the energy addition of the decay heat, Zircaloy-water reaction, and hydrogen combustion. After 75,000 seconds (20.8 hours), the containment pressure rises to the design pressure because the decay heating rate exceeds the heat removal rate. Internal cooling of the containment vessel is required at this time to maintain the containment pressure below the design value. Delayed core spray operation at 900 seconds after the loss-of-cooling accident, the worst time for the core spray to start, results in a short-term containment pressure less than the design pressure. Long-term pressure response caused by the relationship between decay heat rate and heat transfer rate is similar to the case without core spray. The hydrogen-steam mixture flowing through the core reaches the spontaneous ignition temperature at 440 seconds after the initial blowdown. The shock wave pressure at the concrete missile barrier adjacent to the containment vessel wall is 0.05 psi, if the hydrogen emitted prior to 440 seconds is assumed to detonate. Detonation, however, is unlikely since the concentrations of reactants fall outside the detonation limit assuming a stoichiometric mixture of oxygen is supplied from the air-steam mixture in the containment atmosphere. (auth)

7430 RISK PROTECTION, POWER GENERATION, AND FISCAL RESPONSIBILITY. Burnham, J. B. (Battelle Pacific Northwest Labs., Richland, WA). Power Eng.; 77: No. 5, 67-69 (May 1973).

Acceptability criteria for risks, premised on the benefits to be expected, should protect society from all hazards which are of the same magnitude as disease mortality (10,000 deaths per year per 1,000,000 people). Limits for involuntary risk should be commensurate with the benefits of the operation which causes the risk. Benefit/Risk analysis for nuclear power plants is discussed. (FS)

7431 CALCULATED LOSS-OF-COOLANT ACCIDENT: A REVIEW. Ybarrondo, L. J.; Solbrig, C. W.; Isbin, H. S. (Aerojet Nuclear Co., Idaho Falls, ID). AIChE Monogr. Ser.; 68: No. 7, 1-99(1972).

Present calculational procedures used for predicting the thermal and hydraulic response of commercial power reactors to a loss-of-coolant accident are reviewed. The design configurations of present generation PWR and BWR reactor coolant systems are summarized to provide a basis for discussing the analysis methods. Computational models required for each phase of the accident are reviewed and the required interfacing of these various analysis models is described. A basic scheme is described for the analysis of certain hypothetical accidents and the need for a continuing development of methods is identified. (auth)

Reactor Theory and Calculation

Refer also to abstracts 7012, 7266, 7267, 7315, 7316, 7346, 7368, and 7510.

7432 (AAEC/E-227) FAST FISSION RATIO MEASUREMENTS IN MULTI-ROD CLUSTERS. Rose, A.; Jain, H. M.; Menezes, P. F. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Oct 1972. 47p. Dep. NTIS (U. S. Sales Only) $4.50.

A series of experiments to measure ^{238}U/^{235}U fission rate ratios in UO_2 rod cluster fuel elements is described. The measurements utilized the well known gross fission product gamma ray counting technique, with calibration by double-fission chamber and ^{140}La fission product γ-ray counting techniques. Results are given for fast fission ratios measured over a range of simulated light water coolant densities from zero (air) to one (H_2O), the mid ranges being covered by high density expanded polystyrene, in clusters of 7, 19, 37 and 61 14.24 mm diameter UO_2 rods. (auth)

7433 (AAEC/E-254) TIME DEPENDENT ^{237}Np, ^{235}U, AND ^{239}Pu FISSION RATES IN A THORIUM ASSEMBLY DURING THE INTERVAL 0 TO 200 ns USING A PULSED ^{9}Be(d,n) SOURCE. Part 1. Experiment. Moo, S. P.; Rainbow, M. T.; Ritchie, A. I. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Mar 1973. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

A series of integral pulsed neutron experiments performed in a $0.4 \times 0.4 \times 0.4$ m^3 metallic thorium assembly in such a way as to allow direct comparison of space independent reaction rates with calculated reaction rates derived from a code which uses the asymptotic reactor theory approximation to describe leakage is described. The technique relies on the Fourier decomposition of measured space-time dependent reaction rates and the extraction from these of the reaction rate corresponding to the fundamental three-dimensional Fourier spatial mode. The reaction rates measured were the fission rates of ^{235}U, ^{239}Pu and ^{237}Np following a short (~10 ns) burst of neutrons with a mean energy of ~2.7 MeV. (auth)

7434 (AAEW-M-1172) USE OF MURAL FOR CALCULATION OF NEUTRON AGE AND HIGHER MOMENTS OF THE NEUTRON DISTRIBUTION. Spanton, J. H. (Atomic Energy Establishment, Winfrith (England)). Mar 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

A method of calculating neutron age and higher moments of the neutron distribution from a plane source in about 2000 energy groups has been incorporated in the MURAL code. Calculations have been made for graphite and water using the FGL4 cross-section library and the Maxwellian fission spectra with two different temperatures (1.30 MeV—the standard FGL4 value for U-235, and 1.43 MeV). For graphite the higher temperature is in satisfactory agreement with the age and moments measurements but for water a temperature of 1.35 MeV gives the best fit. (auth)

7435 (AAEW-R-788) JOSHUA III: THREE-DIMENSIONAL DIFFUSION CODE WITH THERMAL HYDRAULIC FEEDBACK FOR

FUEL MANAGEMENT STUDIES IN WATER COOLED REACTORS. Pearce, D. F. (Atomic Energy Establishment, Winfrith (England)). Feb 1973. 44p. Dep. NTIS (U. S. Sales Only) $4.25.

JOSHUA III is a two or three-dimensional, two-group, diffusion code with coolant, Doppler and xenon feedback and is intended for fuel management studies with water cooled reactors. The diffusion code BASHAN, provided with cross-sections which are a function of water density and irradiation, is used to calculate the rating distribution for a given density distribution. The rating distribution is subsequently used in a thermal hydraulics routine in order to evaluate a revised density distribution in each channel. Subcooled boiling and interchannel mixing can be represented if required. An iterative procedure between the flux solution and the thermal hydraulics calculations ensures consistency between the rating and density distributions. Corrections as a function of rating can be applied to the cross-sections to allow for the effect of Doppler and xenon feedback. Various features are provided to allow burnup, control rod programs, and refueling schedules to be followed. (auth)

7436 (BNWL-1695) COBRA IIIC: DIGITAL COMPUTER PROGRAM FOR STEADY STATE AND TRANSIENT THERMAL HYDRAULIC ANALYSIS OF ROD BUNDLE NUCLEAR FUEL ELEMENTS. Rowe, D. S. (Battelle Pacific Northwest Labs., Richland, Wash.). Mar 1973. AT(45-1)-1830. 104p. Dep. NTIS $7.25.

The COBRA-IIIC computer program computes the flow and enthalpy in rod-bundle nuclear fuel element subchannels during both steady state and transient conditions using a mathematical model that considers both turbulent and diversion crossflow mixing between adjacent subchannels. Each subchannel is assumed to contain one-dimensional, two-phase, separated, slip-flow. The two-phase flow structure is assumed to be fine enough to define the void fraction as function of enthalpy, flow-rate, heat-flux, pressure, position and time. Steady-state two-phase flow correlations are assumed to apply to transients. The mathematical model neglects sonic velocity propagation; therefore, it is limited to transients where the transient times are greater than the time for a sonic wave to pass through the channel. The equations of the mathematical model are solved by using a semi-explicit finite difference scheme which gives a boundary-value flow solution for both steady state and transients where the boundary conditions are the inlet enthalpy, inlet mass velocity, and exit pressure. COBRA-IIIC contains all the analysis capability of the COBRA-II program; considers transients of fast-to-intermediate speed but no sonic velocity propagation effects are considered; the numerical scheme performs a boundary value solution where the boundary conditions are the inlet flow, inlet crossflow, inlet enthalpy and exit pressure; the numerical solution has no stability limitation on space or time steps; a more complete transverse momentum equation includes temporal and spatial acceleration of the diversion crossflow; a fuel pin model option allows calculation of fuel and cladding temperatures during transients by specifying power density; forced flow mixing due to diverter vanes or wire wraps is included; and improved numerical procedures allow more complete analysis of bundles with partial flow blockages. (auth)

7437 (CEA-CONF-2218) MONTE CARLO PROGRAM IN THREE DIMENSIONAL GEOMETRY: TRIPOLI. Bourdet, L.; Katz, S.; Nimal, J. C.; Vergnaud, T. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1972. 17p. (In French). (CONF-721018-11). Dep. NTIS (U. S. Sales Only) $3.00.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The Monte-Carlo program TRIPOLI calculates the energy and spatial distribution of neutron fluxes and currents in general three-dimensional geometries. The biasing techniques introduced allow the treatment of neutron penetration problems in materials of large thickness to be accomplished in reasonable calculation times. A number of examples of applications of the program are given. (FR)

7438 (EURFNR-1082) FINE GROUP CALCULATIONS FOR REACTIVITY COEFFICIENTS OF STRUCTURAL MATERIALS IN FAST REACTORS. Kiefhaber, E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Feb 1973. 43p. (KFK-1759). Dep. NTIS (U.S. Sales Only) $4.00.

Work performed under United States–Euratom Fast Reactor Exchange Program.

The comparison of calculated and measured reactivity coefficients of individual isotopes or elements may provide a fairly detailed check on the correctness of the important nuclear data for these materials. In order to be able to draw firm conclusions, one must be sure that other possible sources of error besides the data uncertainties can be excluded or at least neglected. One specific source of error is the influence of the energy resolution used in the multigroup formalism on calculated central reactivity coefficients of some isotopes and elements, particularly of predominantly scattering materials in fast reactors. For the calculations we assumed that first order perturbation theory can be applied. The results are based on fundamental mode diffusion calculations for the homogeneous composition. As a starting point we used the 208 group scheme which consists of 196 fine groups above 1 keV. The transition to the coarse group energy scheme of 26 groups was obtained by group collapsing. Besides the usual normal flux weighting we have also applied bilinear weighting which takes into account normal and adjoint fluxes. The results indicate that the usual 26 group calculations of reactivity coefficients especially for predominantly scattering materials may lead to appreciable deviations from more refined treatments with better energy resolution. These deviations are essentially due to discrepancies in the adjoint flux obtained with flux weighted coarse group constants. Bilinear weighting for the preparation of coarse group constants avoids these difficulties. (auth)

7439 (FEI-298) INDICES OF THE EFFECTIVENESS OF REACTOR MATERIALS AND FACTORS OF NEUTRON LEAKAGE. Levin, V. E.; Pupko, V. Ya. (Gosudarstvennyi Komitet Po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1972. 20p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

A theory of the indices of effectiveness of reactor materials and neutron leakage factors was developed. Changes in the dependence of these values on the reflector thickness and core composition were investigated in examples of homogeneous spherical reactors. (tr-auth)

7440 (FEI-361) ANALYSIS OF INTEGRAL DATA WITH THE PURPOSE OF PREDICTING REACTOR PERFORMANCE. Van'kov, A. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1972. 51p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.75.

The problem of analysis of a reactor physics experiment was solved with the aim of perfecting the predicted characteristics of a fast reactor. The approach outlined differs from the approach directed toward correction of constants, and involves a determination of a direct connection between functionals on the basis of their correlation properties. The possibility of evaluating a covariance matrix of constants using only integral data is demonstrated. In line with the formalism which uses sensitivity coefficients, an idea is advanced for solution of the problem by randomization of group constants in reactor calculation. (tr-auth)

7441 (HEDL-TME-73-35) MITRAN: A COMPUTER PROGRAM TO CALCULATE MICROCOMPOSITION DATA FROM MICROPROBE STEP SCANS. Clark, W. I.; Watkins, J. C.; Russell, W. J.; Carlson, M. C. J. (Hanford Engineering Development Lab., Richland, Wash.). Feb 1973. Contract AT (45-1)-2170. 29p. AT $4.00.

An analysis scheme utilizing a scanning electron microprobe and a computer analysis program has been developed to evaluate compositional distributions within specimens. The characteristics evaluated are: mean region size, mean region compositions, percent of total sample in regions, and region size-composition histograms describing the sample heterogeneities. Data collection techniques including preparation and microprobe application and data reduction including the calculational scheme for output parameters are discussed. (auth)

7442 (JUL-CONF-7, pp 83-117) COMPLEX PROBLEM IN REACTOR DYNAMICS. Lauer, A. (Kernforschungsanlage, Juelich, Ger.). Oct 1972. (In German).

From information conference on date prepared in research; Juelich, Germany (12 Oct 1972).

The study of xenon oscillations in large thermal nuclear reactors required the solution of partial differential equations for the neutron flux dependency on space and energy as well as the calculation of time changes in the xenon distribution. For this purpose, a comprehensive modular program system (ASTERIX) was developed which, based on the neutron diffusion theory, permitted simulation and analyzing of the space-time core behavior. The program took into account the retroaction of both xenon and control rods. The immensity and the complexity of the data evaluation problem necessitated the use of a large computer with many additional components, one of which was a graphic display system for the optical analysis of xenon transients. (HBG)

7443 (ORNL-TM-4179) IMPROVED REPRESENTATION OF SOME ASPECTS OF CIRCULATING-FUEL REACTOR KINETICS. Prince, B. E. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 38p. Dep. NTIS $4.00.

The general space-energy dependent reactor kinetic equations for a circulating-fuel reactor were studied to help determine the type of mathematical representation most appropriate for analysis and computation of reactor transient behavior. It is shown that, with inclusion of fluid transport terms in these equations, the application of the usual adjoint-weighting and integration techniques used to derive "global" kinetic equations from the general equations does not result in the usual set of time-dependent ordinary differential equations associated with stationary-fuel reactor-kinetics. However, a time-dependent integro-differential equation describing the kinetics of the neutron population can still be obtained. General formulas for calculating the weighted delayed-neutron precursor kernels in this equation are given, and a numerical example is included which illustrates the nature of the solution. Directions are also suggested for calculating the analogous weighted temperature-distribution kernels for analysis of power-temperature kinetics. The qualitative influence of fluid mixing on the kernels is described, and the connections between the distributed parameter and lumped-parameter representations of the system kinetics are also discussed. (auth)

7444 (ORO-3443-43) MATHEMATICAL AND COMPUTATIONAL PROBLEMS IN REACTOR CALCULATIONS. Babuska, I.; Kellogg, R. B. (Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). Mar 1973. Contract AT(40-1)-3443. 29p. (BN-760). Dep. NTIS $3.50.

Two computational problems connected with the solution of the neutron diffusion equation and neutron transport equation are considered. The first problem, called the local problem, arises from the presence of material interfaces and their effect on the differentiability of the solution. The second problem, called the global problem concerns lattice geometries and the use of homogenization procedures. For both problems there is an informal discussion of the mathematical situation and of some numerical experiments. (auth)

7445 (RD/B/N-2389) PINMOC: A MONTE CARLO CODE FOR ESTIMATING FIRST-FLIGHT PROBABILITIES IN A TWO DIMENSIONAL PIN CLUSTER. Bending, R. C.; Parkes, G. E. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Jan 1973. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

Several types of nuclear reactor make use of a lattice cell in which a cluster of cylindrical fuel pins or coolant channels are contained within a hexagonal or rectangular boundary. Reactor physics calculations for such a reactor may require the cell to be smeared to give an equivalent homogeneous mixture of materials. The smearing process requires special techniques whenever the nuclear cross-sections vary widely from point to point in the cell, particularly in the neutron resonance energy range. The program PINMOC has been written to provide rapid estimates of some of the parameters required for analytic smearing calculations, taking into account the geometry of the pin cluster. Monte Carlo methods are used to track neutrons (or gammas), in one energy group, to their first collision only, and to derive various probabilities associated with the properties of the cluster. The code will accept most lattice cell arrangements with straight cell boundaries, and allows pins to enclose one another or intersect the boundary. An isolated pin cluster may also be represented by suitable modification of the data. (auth)

7446 (RISO-M-1568) CRS: A CODE TO PRODUCE MULTIGROUP NEUTRON CROSS SECTIONS FOR REACTOR PHYSICS CALCULATIONS. Hvidtfeldt Larsen, A. M. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1973. 35p. Dep. NTIS (U. S. Sales Only) $3.75.

The CRS program is a multigroup cross section code, written in ALGOL for the Burroughs B6700 computer. It needs as input the so-called MASTER TAPE containing fine group cross sections and scattering matrices, and these data are in CRS made complete with thermal scattering data and shielded resonance cross sections. Spectrum calculation and condensation to fewer groups may be performed. The program has a number of output options, corresponding to different reactor physics codes in current use at Risø. (auth)

7447 (STI/PUB-307) NUMERICAL REACTOR CALCULATIONS. Proceedings Series. Proceedings of a Seminar Held at Vienna, January 17-21, 1972. (International Atomic Energy Agency, Vienna (Austria)). Aug 1972. 830p. (In French and English). (CONF-720104-). $26.00.

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972).

Separate abstracts are included for 45 of the 47 papers presented on reactor physics calculations. Two of the papers have been previously abstracted and are listed in NSA under the following abstract numbers: 26:49325 and 25:1871. (DCC)

For abstracts of individual papers see: 7266, 7267, 7315, 7316, 7346, 7368, 7457-7494, and 7510.

7448 (STI/PUB-336) REACTOR BURN-UP PHYSICS. Panel Proceedings Series. Proceedings of a Panel, Vienna, 12-16 July 1971. (International Atomic Energy Agency, Vienna (Austria)). 1973. 303p. (In Several Languages). (CONF-710724-). IAEA $10.00.

Separate abstracts were prepared for each of the 20 papers included. (JWR)

For abstracts of individual papers see: 7263-7265, 7274-7277, 7299-7301, 7309-7313, 7344, and 7450-7453.

7449 (TID-25951) REACTOR SHIELDING FOR NUCLEAR ENGINEERS. Schaeffer, N. M. (ed.). (Radiation Research Associates, Inc., Fort Worth, Tex.). 1973. 801p. Dep. NTIS $13.60.

Chapters are included on historical background; sources of radiation; interactions of radiation with matter; radiation transport; Monte Carlo methods for radiation transport; shield attenuation calculations; albedos, ducts, and voids; shield heating, air transport, shield materials, and shield optimization; experimental shielding; and shield design. (JWR)

7450 NEEDS AND AVAILABLE CALCULATION TOOLS IN THE FIELD OF HOMOGENEOUS METHODS FOR POWER-DISTRIBUTION AND FUEL EVOLUTION ANALYSIS OF OVERALL REACTORS. Rinaldini, C. (EURATOM-CCR, Ispra, Italy). pp 117-123 of Reactor Burn-Up Physics. Vienna; International Atomic Energy Agency (1973).

From IAEA panel on reactor burn-up physics; Vienna, Austria (12 Jul 1971). See STI/PUB-336; CONF-710724-.

Several techniques used in the solution of one- to three-dimensional neutron diffusion problems are reviewed: the modal approach (including synthesis methods) and a number of nodal approaches are considered, in alternative to or in combination with the finite-difference technique. Specific advantages and disadvantages are pointed out in view of the application to the fuel burn-up evaluation in the overall reactor. Typical computer programs suited to the calculation of large thermal power reactors are described and their main features in connection with practical applications are mentioned. The foreseeable future needs in this field are outlined. (auth)

7451 NEUTRONIC EVOLUTION OF FUELS IN THERMAL-NEUTRON REACTORS AS A FUNCTION OF IRRADIATION. Laponche, B.; Vidal, R. (CEN, Saclay, France). pp 227-237 of Reactor Burn-Up Physics. Vienna; International Atomic Energy Agency (1973). (In French).

From IAEA panel on reactor burn-up physics; Vienna, Austria (12 Jul 1971). See STI/PUB-336; CONF-710724-.

The main questions in the field of fuel depletion in nuclear reactors deal with the prediction of composition changes in the fuels, correct calculations of neutron balance and calculations of power distribution. Owing to the complexity of the problem, a check of calculation methods has to be made by a set of experiments, each experiment corresponding to a particular point: such a set was applied to graphite-gas cooled reactors and, at a less extent, to heavy water reactors. The experimental program has three steps: (a) chemical and isotopic analyses on irradiated fuels, to check depletion calculations and adjust the main parameters responsible for the formation and disappearance of heavy nuclei; (b) critical experiments (progressive replacement and oscillations) with Pu-bearing fuels, to give reaction rates for this kind of fuel and to define a consistent "evaluated" set of cross-sections for plutonium isotopes; (c) oscillation experiments on irradiated fuels, to give the fuel total absorption, from which the fission product absorption can be deduced. This kind of program is a "benchmark" program, which will be applied to depletion studies on light water reactors and high-temperature reactors. (auth)

7452 REVIEW OF EXPERIMENTAL METHODS FOR THE DETERMINATION OF NUCLEAR FUEL BURN-UP. Fudge, A. J. (Atomic Energy Research Establishment, Harwell, Eng.). pp 239-248 of Reactor Burn-Up Physics. Vienna; International Atomic Energy Agency (1973).

From IAEA panel on reactor burn-up physics; Vienna, Austria (12 Jul 1971). See STI/PUB-336; CONF-710724-.

The methods used for the experimental determination of nuclear fuel burn-up depend either on the measurement of fission product nuclides produced in known yield or on the change in isotope composition of the heavy-element nuclei brought about by irradiation. The stable fission product nuclide methods are described and reasons given for the ultimate choice of ^{148}Nd as the favored monitor nuclide. An estimate of the errors involved in the measurement indicates that the method is capable of measuring burn-up to within ±2.3% for a single determination. The advantages and disadvantages of the use of radioactive fission product nuclides is given together with the overall error estimated for the method of ±3.1% under favourable conditions. The measurement of the isotopic composition of the heavy-element nuclei by surface-ionization mass spectrometry is discussed and values of the precision of measurement of the isotopes of uranium and plutonium are given for different isotopic compositions. It is shown that from this assessment of the precision and accuracy of the different methods the target accuracies suggested can be met. (auth)

7453 BURN-UP DETERMINATION BY IRREVERSIBLE ADMIXTURE OF FLUENCE-MONITORING NUCLIDES TO NUCLEAR FUEL. Muench, E. (Kernforschungsanlage, Juelich, Ger.). pp 249-254 of Reactor Burn-Up Physics. Vienna; International Atomic Energy Agency (1973).

From IAEA panel on reactor burn-up physics; Vienna, Austria (12 Jul 1971). See STI/PUB-336; CONF-710724-.

A method of non-destructive determination of nuclear fuel burn-up is described. Since the analysis of fission product activities may give rise to severe uncertainties because some essential requirements for exact evaluation are not fulfilled, special fluence-monitoring nuclides with γ-rays in the energy region between 1.0 MeV and 1.4 MeV were admixed to the fuel. After irradiation in a reactor, burn-up may be obtained from the activity of the admixed nuclide, determined by means of a highly resolving lithium-drifted germanium detector. The measurement can be carried out without any separation of the nuclide from the nuclear fuel since the region from 1.0 MeV to 1.4 MeV in the fission-product spectrum is free of fission-product peaks some 50 hours after the end of irradiation. Three nuclides, ^{109}Ag, ^{64}Zn and ^{59}Co are suitable for burn-up determination in a reactor with thermal neutron spectrum. Possibilities of admixture to the nuclear fuel are mentioned and some aspects of the quantity of admixture are treated. Relative burn-up determinations of coated particles with cobalt admixture delivered results with an uncertainty of ±10% for burn-up values between 0.6% and 2.9% without any knowledge of irradiation history. The error sources are discussed and proposals for measurements with higher precision are made. (auth)

7454 STABILITY OF NUCLEAR REACTORS WITH CHANGES IN EIGENVALUE. Nguyen, D. H. (Naval Postgraduate School, Monterey, CA). Nucl. Sci. Eng.; 50: No. 4, 370-381(Apr 1973).

The stability of a nuclear reactor with prompt feedback is examined when its eigenvalue (size, material buckling) is increased or decreased. Two models describing the temperature dependence of the Doppler coefficients T^{-1} and $T^{-1/2}$ are used in the analysis, and their relative effectiveness in maintaining stability is compared. Both the eigenvalue and neutron flux of the nonlinear reactor are expanded in the perturbation parameter ϵ, defined as the spatially weighted average of the change in neutron flux relative to the flux of the linear reactor. For a change in reactor eigenvalue, the equilibrium states of the neutron flux are obtained, accurate to the first order of feedback, but to an arbitrary order of perturbation. The stability of each state is examined. It is found that even for an overall negative prompt feedback, there exists a limit to the increase in reactor eigenvalue (or in neutron flux), beyond which instability may result. This limit depends on the initial conditions of the perturbed reactor. The neutron flux is shown to be more sensitive to a change ϵ than the reactor eigenvalue, and this sensitivity depends on the temperature variation of feedback. It is also shown that the T^{-1} variation of the negative Doppler coefficient is more effective than the $T^{-1/2}$ variation in maintaining reactor stability when the reactor eigenvalue is increased. (auth)

7455 REACTOR PHYSICS. Zweifel, P. F. New York; McGraw Hill Book Company (1973). 329p. $17.50.

Methods are described for making reactor physics calculations which describe neutron distribution in a reactor or critical or experimental assembly. Physical bases upon which reactor designs are made are developed. The first seven chapters are devoted to one-group theory treating problems of neutron distribution, criticality of bare and reflected reactors, kinetics, long-term reactivity effect, and reactor control. The multigroup method is then introduced and used for energy dependent problems and slowing-down calculations. Descriptions of theories applicable to specific types of reactors are given. (FS)

7456 EXTRAPOLATED ENDPOINT FOR THE UNIFORM SOURCE HALF SPACE PROBLEM. Petrick, W. P. (General Electric Co., San Jose, CA); McDaniel, C. T.; Leonard, A. Nucl. Sci. Eng.; 50: No. 4, 388-390(Apr 1973).

The Wiener-Hopf technique is applied to obtain the solution for the extrapolated endpoint for an infinite half-space problem containing a uniform isotropic source, and this endpoint is compared to the Milne extrapolated endpoint. Another definition of extrapolated endpoint for use in diffusion theory based on the interior flux for the uniform source half-space problem is given and compared to the equivalent uniform source diffusion theory endpoint. (auth)

7457 NEW FORMULATION AND COARSE-MESH ACCELERATION FOR TWO-DIMENSIONAL DS_N AND P_N METHODS. Nakamura, S. (Ohio State Univ., Columbus). pp 51-82 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). See STI/PUB-307; CONF-720104-.

New equations for the two-dimensional DS_N method as well as methods of coarse-mech acceleration for two-dimensional DS_N and P_N iterative solutions are presented. The new DS_N equations are entirely free from negative flux, flux oscillation, and have a less pronounced ray effect, all of which have been serious deficiencies of the current two-dimensional DS_N equations based on the diamond difference approximation. The new method utilizes spatially discrete fluxes which have been used in the diamond difference approximation. A directional flux is interpreted as the intensity of the distribution function for neutrons in an angular sub-space rather than a mono-directional neutron beam. The neutron Boltzmann equation is solved exactly for all kinds of mesh boxes externally to the iterative scheme. Using "transmission coefficients" and "source coefficients," the new equation is reduced to the same form as the current equation, so that all the iterative schemes for the current solutions can be used. The convergence rate for the new equation was found to be faster than that for the current DS_N equation. A coarse-mesh angle-dependent rebalancing method for the DS_N method is developed. This method only accelerates early cycles of the iteration. However, the present method has been found more effective than the current coarse-mesh rebalancing method. The reason why the acceleration effect is not uniform is discussed in connection with the diamond difference approximation. Two-dimensional P_N equations have been scarcely used owing to their complexity and slow convergence rate of iterative solution. It is shown that the second problem can be removed by applying the coarse-mesh acceleration method. The coarse-mesh acceleration techniques, which have been developed for two-dimensional diffusion equations, can be applied directly to P_N equations. Difference approximations for the P_3 equation are derived and an accelerated iterative scheme is developed. Computation time of a two-dimensional P_3 equation is compared with DS_N solutions. (25 references) (auth)

7458 FINITE-DIFFERENCE SOLUTION OF THE SPACE-ANGLE LETHARGY-DEPENDENT SLOWING-DOWN TRANSPORT EQUATION. Matausek, M. V. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 83-93 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). See STI/PUB-307; CONF-720104-.

A procedure has been developed for solving the slowing-down transport equation for a cylindrically symmetric reactor system. The anisotropy of the resonance neutron flux is treated by the spherical-harmonics formalism, which reduces the space-angle-lethargy-dependent transport equation to a matrix integro-differential equation in space and lethargy. Replacing further the lethargy transfer integral by a finite-difference form, a set of matrix ordinary differential equations is obtained, with lethargy- and space-dependent coefficients. If the lethargy pivotal points are chosen dense enough so that the difference correction term can be ignored, this set assumes a lower block triangular form and can be solved directly by forward block substitution. As in each step of the finite-difference procedure a boundary value problem has to be solved for a non-homogeneous system of ordinary differential equations with space-dependent coefficients, application of any standard numerical procedure, for example, the finite-difference method or the method of adjoint equations, is too cumbersome and would make the whole procedure practically inapplicable. A simple and efficient approximation is proposed here, allowing analytical solution for the space dependence of the spherical-harmonics flux moments, and hence the derivation of the recurrence relations between the flux moments at successive lethargy pivotal points. A computer code has been developed for the CDC-3600 computer, which uses the KEDAK nuclear data file. The space and lethargy distribution of the resonance neutrons can be computed in such a detailed fashion as the neutron cross sections are known for the reactor materials considered. The computing time is relatively short so that the code can be efficiently used, either autonomously, or as part of some complex modular scheme. Typical results will be presented and discussed in order to prove and illustrate the applicability of the method proposed. (10 references) (auth)

7459 USE OF FAST FOURIER TRANSFORMS FOR SOLVING PARTIAL DIFFERENTIAL EQUATIONS IN PHYSICS. Le Bail,

R. C. (CERN, Geneva). pp 95-112 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). See STI/PUB-307; CONF-720104-.

The use of fast Fourier techniques for the direct solution of an important class of elliptic, parabolic, and hyperbolic partial differential equations in two dimensions is described. Extensions to high-order and higher-dimension equations as well as to integro-differential equations are presented, and several numerical examples with their resulting precision and timing are reported. (12 references) (auth)

7460 RIGOROUS ANALYSIS OF THE DIAMOND APPROXIMATION FOR THE NEUTRON TRANSPORT EQUATION. Arkuszewski, J. J. (Inst. of Nuclear Research, Swierk, Poland). pp 113-123 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). See STI/PUB-307; CONF-720104-.

The major part of contemporary discrete S_N codes employ a specific box concept that requires an auxiliary formulation of the relation between edge values of the angular flux and the box value representative for the box interior. Usually the "diamond" or "weighted diamond" scheme is used as this relation. It can be shown, however, that this approach is equivalent to a particular double staggered finite difference scheme that can be investigated by the rigorous approximation theory. It is shown that various versions of this scheme corresponding to different values of the coefficients in the weighted diamond scheme can differ significantly as far as the order of approximation is concerned. In general, the approximation of these schemes never exceeds the first order, which is corroborated by the numerical investigation of their convergence. The existence of the latter, however, indicates that the schemes are usually fairly stable, although there is no rigorous proof of this fact. Some generalizations unknown in the original formulation of the diamond scheme, together with the not always essential requirements concerning positivity of the schemes, are also discussed. It is shown that the double staggered scheme is inapplicable in boxes crossed by the singular characteristic. Some numerical examples are given. (7 references) (auth)

7461 BOX EXPLICIT METHOD IN ONE-DIMENSIONAL SPHERICAL GEOMETRY. Kulikowska, T. (Inst. of Nuclear Research, Swierk, Poland). pp 125-138 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). See STI/PUB-307; CONF-720104-.

The results obtained from rigorous investigation of the approximation for the neutron transport equation in rectangular geometry indicate that the schemes based on the "box explicit method" might furnish an efficient tool for the numerical solution of that equation. Their extension to curved geometries was considered with one-dimensional spherical geometry, as the simplest case, being analysed first. The properties of the analytical solution of the differential problem are examined and the existence of a singular point is shown. The standard procedure of splitting up the problem into two equations with non-negative coefficients is applied. The properties of these equations essential for the finite differencing procedure are briefly discussed. The finite difference operator based on four meshpoints is constructed. This operator approximates each of the corresponding differential operators with the second order of accuracy. The explicit formulae of the finite difference coefficients are given, which are valid both for the interior of the regions considered and for close to their boundaries. A test program was written that solved the finite difference equations for a simple case where the exact solution was known at each point. The errors in maximum and L^2 norms and the point errors of the finite difference solutions were calculated. The results show the influence of the singular point on the magnitude of errors and convergence of the finite difference solution. For comparison the results obtained by the application of the diamond scheme with coefficients taken at midpoints of mesh intervals are presented. (8 references) (auth)

7462 APPROXIMATION THEORY FOR THE NEUTRON TRANSPORT EQUATION IN RECTANGULAR GEOMETRY. Mika, J. (Inst. of Nuclear Research, Swierk, Poland). pp 139-152 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). See STI/PUB-307; CONF-720104-.

The classical approach to the finite difference approximation in neutron transport theory, as applied in existing S_N codes, proceeds from considerations based to a great extent upon physical intuition. Thus such important aspects of the finite difference schemes as approximation, stability and convergence have never been investigated systematically. This seems to be the main reason for the difficulty permanently encountered in the practical application of S_N codes. A different approach is presented based upon the rigorous approximation theory to derive the finite difference equations corresponding to the stationary neutron transport equation in two-dimensional rectangular geometry. This leads to the "box explicit method." The characteristic feature of this method is that the neutron distribution is considered in a certain set of meshpoints and the source and the equation itself in another set of meshpoints representing the "box" values. A short presentation of the general theory of finite difference approximation and the basic definitions and theorems are included. The theory is then applied to the two-dimensional transport equation in rectangular geometry to give a set of difference equations for the "box explicit method." Thorough analysis of the exact solution to the transport equation shows the existence of a discontinuity of the first derivative along the "singular" characteristic. The effect of this characteristic is properly taken into account and the consistency of approximation remains intact. The preliminary numerical results are in agreement with the theoretical considerations. (9 references) (auth)

7463 ITERATIVE METHODS OF SOLVING THE TRANSPORT EQUATION. Lebedev, V. I. (Inst. of Atomic Energy, Moscow). pp 153-155 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). See STI/PUB-307; CONF-720104-.

A survey of a number of iterative methods of solving the transport equation is given. For further details, reference is made to the book by Marchuk and Lebedev on numerical methods in the theory of neutron transport. (auth)

7464 INTEGRATION OF DIFFERENTIAL EQUATIONS BY MEANS OF LIE SERIES AND VARIOUS NUMERICAL METHODS: COMPARISON OF SPEED AND RELIABILITY. Mennig, J.; Auerbach, T.; Brunner, J.; Haelg, W.; Halin, J. (Eidgenoessische Technische Hochschule, Zurich). pp 157-182 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

Four sample problems taken from the literature were used in comparing a number of methods with respect to their computing times and stability. Lie series were compared with five numerical methods: extrapolation method of Bulirsch-Stoer, predictor-corrector, 4th-order Runge-Kutta with constant step size ("Runge-Kutta 1"), and two Runge-Kutta methods with variable step size. Results of calculations show Lie series to be superior when applied to two of the problems, both of them linear. For nonlinear problems, however, Bulirsch-Stoer is shown to be faster than Lie series. Among the methods employing automatic step size control Lie series and Bulirsch-Stoer turn out to be particularly reliable. On the other hand, neither of the two variable-size-step Runge-Kutta methods was able to attain the accuracy specified. Application of Lie series is recommended whenever the problem leads to a fixed number of terms in the recursion relation for the ν-th derivative of the function sought. (22 references) (auth)

7465 REVIEW OF THE STATUS OF COLLISION PROBABILITY METHODS. Askew, J. R. (Atomic Energy Establishment, Winfrith, Eng.). pp 185-196 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

Methods for the calculation of collision probabilities are briefly reviewed with special emphasis on those for two-dimensional geometries. An attempt is made to identify the key features of this integral representation of neutron transport which will have a bearing upon its performance relative to differential representations and hence the choice of solution technique appropriate to particular classes of problem. (25 references) (auth)

7466 C_N METHOD OF SOLVING THE TRANSPORT EQUATION: APPLICATION TO PLANE GEOMETRY. Benoist, P.; Kavenoky, A. (CEN, Saclay, France). pp 211-229 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972). (In French).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

A form of the transport equation is presented based on a lemma proved by Placzek. An integral equation is obtained for the angular density at the limits of the various media. The nucleus of this integral equation is Green's function for an infinite medium. Knowledge of the angular densities at the boundaries of the media allows calculation of the fluxes at all points, and is sufficient for the solution of a large number of problems. Thus, the complexity of the calculation is independent of the dimensions of the media considered. This equation is solved by developing the angular density on a basis, and C_N is called the approximation in which the series is truncated at the order N. This method has been applied to several problems in plane and cylindrical geometries, in monokinetic theory, and to certain spectral problems. The method presented can be used to deal with a stack of plates used to form either a heterogeneous cell or a reactor with several zones. A system of linear equations is obtained for the angular densities at the boundaries, the matrix elements of which comprise the albedo and the transmissions calculated. This method makes little demand on the computer and is very fast, primarily because the calculation time is independent of the dimensions and the media; it is well suited to small computers. (16 references) (auth)

7467 INTEGRAL FORM OF THE TRANSPORT EQUATION: POLYNOMIAL APPROXIMATIONS AND ANISOTROPIC DIFFUSION. Ligou, J.; Stepanek, J.; Thomi, P. A. (Institut Federal de Recherches en Matiere de Reacteurs, Wuerenlingen, Switzerland). pp 231-265 of Numerical Reactor Calculations. Vienna; International Atomic Energy Commission (1972). (In French).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). See STI/PUB-307; CONF-720104-.

Two difficulties are usually encountered when applying the integral theory of transport: the variations in the flux must be limited, which excludes systems of large dimensions, and the anisotropy of the diffusion seriously complicates the formalism. An attempt must therefore be made to improve the methods in these two respects. First of all, various methods are compared for a simple case (critical plate): direct integrations (of the Gauss, Euler, trapezoidal type), utilization of collision probabilities, Fourier or Taylor series and, first and foremost, Legendre's polynomials. It emerges from this initial study that the last of these methods is the best one. Having adopted this method, a cylindrical geometry comprising several zones is considered, and also the anisotropy of diffusion. The use of differential relationships between angular momentums reduces the number of integral equations to that strictly necessary. The system is then analysed in terms of annuli, for each of which the polynomial approximation is adopted. It is found that the maximum degree of the polynomials is closely linked with the order of the angular momentum under consideration. The SHADOK multi-group code is based on these ideas. It is limited to linear anisotropy, and the polynomials comprise four terms for the fluxes and three for the currents. The examples are of three types: (1) the calculation of cells; (2) the penetration of shields by neutrons; and (3) the calculation of the criticality of mixed fast/thermal systems. Even for systems of large dimensions (second and third cases) the proposed method is faster than the S_N method, particularly if the latter requires an order of quadrature in excess of four. Finally, as compared with the collision probability theory, the number of annuli required is 5 to 10 times less. (17 references) (auth)

7468 INTEGRAL TRANSPORT CALCULATIONS OF THE EFFECTIVE MULTIPLICATION FACTOR AND REACTOR PERIOD. Borysiewicz, M.; Stankiewicz, R. (Inst. of Nuclear Research, Swierk, Poland). pp 267-282 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

Methods of calculating the effective multiplication factor and reactor period based on multigroup integral transport equations are presented. The original integro-differential eigenvalue problems are transformed into the auxiliary eigenvalue problem for the compact integral operator. This depends on parameters whose values correspond to the multiplication factor and reactor period, respectively, when the largest eigenvalue of the integral operator is equal to unity. It is proved that the largest eigenvalue of the integral operator exists and is positive, simple and unique. The corresponding eigenvector is non-negative and uniquely determined up to the normalization constant. These properties admit the large class of iterative schemes solving the auxiliary eigenvalue problem. Two numerical codes have been prepared. In both codes the algorithms consist of external and internal iteration schemes. In internal iteration the auxiliary eigenvalue is calculated by the power iteration procedure. The power iteration is repeated several times to obtain the auxiliary eigenvalue equal to unity. The important point of the methods is the discretization of the spatial dependence of the integral operator. It is shown that the "discrete integral transport method" is the most efficient of the known approximations of the integral kernel. This method, being a pointwise representation of space, permits a Gaussian integration over the space coordinates. The present versions of these codes have been developed for a one-dimensional geometry, black boundary condition and under the additional assumption that the scattering anisotropy can be properly treated by transport-corrected cross sections. The method can be extended to more complicated physical situations. Some numerical results are presented to show the influence of the number of groups and space points on the accuracy of the solution and computer time needed. (10 references) (auth)

7469 INTEGRAL TRANSPORT THEORY OF COLLISION PROBABILITIES AS A TOOL FOR SOLVING REACTOR-CELL PROBLEMS OF STRONG HETEROGENEITY. Penndorf, K.; Schulz, G. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Shiffahrt mbH, Hamburg). pp 283-304 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

Treating burnable poisons and finding group-dependent extrapolation lengths at a control-rod surface has two contradictory features, as far as economy is concerned: (1) application of transport theory is indispensable; (2) both problems demand a large amount of calculation in designing a reactor. To reduce the input of effort, the methods of integral transport will be useful. So a multigroup transport burnup code for axially infinitely extended cylindrical cells has been developed, which enables the alternative use of first-flight collision-probability matrices produced according to the well-known theories of Bonalumi-Jonsson, Carlvik and Honeck, respectively, which contain different degrees of approximation. Validity and limitations of the first-flight concept are explained by the examples given. The linear system of transport equations is solved by iteration and, for the purpose of comparing the calculation times, by matrix inversion. The code is checked by several realistic cases occurring in thermal-reactor design, i.e. by some calculations of poison pin cells and a control rod cell of a high-temperature reactor. All these calculations will be proved by their exact correspondence with Carlson's SN-calculations. The following relative deviations of the integral transport results from the SN-solutions turned out to be significant: (1) criticality values of 0.5-0.6%; (2) poison concentrations after a burnup of 95% of the initial value amounting to 1.0-1.5%; (3) self-shielding factors of 1.0-2.5%. As far as the last item is concerned, there are some higher deviations connected with very low absolute values of the self-shielding factors. For poison pins of any heterogeneity, the running times differ by factors of 11-40 in favor of the integral transport calculations, which correspond to absolute times of 11-45 s on a CONTROL-DATA 3400 computer. Multi- and few-group cases with low and high numbers of zones, according to the possibilities of the computer memory, have been treated. It has turned out that a 16 K of words memory will be sufficient for all practical cases. Several cases could even be run on computers having an 8 K of words memory only. (16 references) (auth)

7470 CALCULATION OF THE RESONANCE SELF-SHIELDING IN COMPLEX CELLS BY THE METHOD OF SUB-GROUPS. Khairallah, A.; Recolin, J. (CEN, Cadarache, France). pp 305-317 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972). (In French).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

In most fast-neutron critical models one or more resonance isotopes are present in several regions of the elementary cell of the lattice having different atomic densities. Even when this is not the case, it is often desirable to determine the fine structure of the resonance self-shielding in the cell. Situations such as these, in which the classical equivalence theorem is insufficient, have prompted studies aimed at the development of new calculation methods. In these methods use is made of the integral transport equation in its discrete form (collision probabilities). The first method consists in calculating the collision probabilities for each resonance isotope as a function of the total cross-section of the isotope concerned, and in adjusting them with a series of rational fractions. In this way the self-shielding in each region of the cell can be calculated on the basis of tables of self-shielding factors for homogeneous media. In the method proposed the resonance cross-sections are represented by "sub-groups," i.e. by a set of discrete values, with each of which a weight is associated. This set of parameters, which are adjusted in order to re-introduce the self-shielding factors correctly, replaces the tabulation of the latter. The justification is given for the use of these sub-groups in calculating the resonance self-shielding both in homogeneous and heterogeneous cells. As the experiment showed that a maximum of four sub-groups per reaction and per energy group is sufficient, the main advantages of this method over the first method are limitation of the number of collision probabilities to be calculated and the absence of any need to adjust collision probabilities. This means an appreciable saving in machine time, which can be as high as a factor of 30 in the case of complex cells. The method of sub-groups is used in the HETAIRE code. In its present stage of development HETAIRE is suitable for unidimensional (cylindrical or plane) or two-dimensional cells. It can be used to calculate self-shielding not only in the fuel regions of the cell, but also in activation detectors (particularly in fission chambers) or resonance samples placed in some region of the cell. In addition, it can be used for supplementary balance calculations by the basic method and for the generation of homogeneous multi-group cross-sections applicable in reactor calculations. (7 references) (auth)

7471 INTEGRAL TRANSPORT THEORY CALCULATION METHOD OF THERMAL NEUTRON FLUX DISTRIBUTION IN TWO-DIMENSIONAL HEXAGONAL GEOMETRY. Patrakka, E.; Saastamoinen, J. (State Inst. for Technical Research, Otaniemi, Finland). pp 319-327 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

The methods used in the integral-transport-theory computer program TRANSHEX to solve the multigroup thermal neutron flux distribution arising from a known epithermal flux in two-dimensional hexagonal geometry are presented. The program has been applied to determine the fission power distribution in WWER-type fuel elements. The program is based on the use of isotropic-emission-density flat-flux collision probabilities between trigonal space regions. The probabilities calculated by a ray-tracing technique are integrated probabilities over both regions concerned. The method used to determine these probabilities is discussed in detail. It involves a great deal of flexibility in varying the sizes of the regions which greatly reduces computer storage requirements. Isotropic return boundary conditions and the over-relaxation iteration technique with renormalization and extrapolation are used. Data are given of the program execution time and storage requirements compared to those of a corresponding diffusion theory program. (17 references) (auth)

7472 SOLUTION OF INTEGRAL TRANSPORT EQUATION IN SPACE AND ENERGY POINTS WITH POLYNOMIAL INTERPOLATION. Bosevski, T.; Pop-Jordanov, J. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 329-340 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

The space- and energy-dependent solution of the integral transport equation is sought in the Lagrangian form of parabolic interpolation between fixed points. The transport equation is, consequently, transformed into a system of linear algebraic equations defining the neutron flux in a set of space and energy points. Using r^2 as interpolation variable in cylindrical geometry, it was possible to develop a partially analytical treatment for determining the coefficients of the algebraic system. According to the nuclear characteristics of the media, the energy region was divided into several sub-intervals, each with a suitably chosen interpolation variable. The distribution of space and energy points was conveniently chosen with the aim of obtaining the most accurate integral reaction rates. The calculations of some typical cases have shown the superiority of the proposed method over the commonly used transport-theory procedures. (10 references) (auth)

7473 SOME BOUNDARY CONDITION PROBLEMS ARISING IN THE APPLICATION OF COLLISION PROBABILITY METHODS. Askew, J. R. (Atomic Energy Establishment, Winfrith, Eng.). pp 343-356 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

Although collision probabilities have been widely used for calculations on lattice cells in infinite arrays, very significant approximations are needed to relate the results of such calculations to problems encountered in the design and operation of reactors. Two approaches to this general problem are briefly discussed. The first is to use improved "return-probability" boundary conditions, obtained typically from whole-reactor diffusion-theory model calculations, to permit a detailed "snapshot" of a region of the reactor to be obtained using collision probability methods. It has been shown that, for the particular case presented, physical considerations permit the boundary conditions obtained from a diffusion theory calculation to be upgraded to a full transfer matrix between the faces of the cell with a resultant reduction in sensitivity to its representation in the approximate calculation. The second type of problem studied may be regarded as an extension of the first in which the surroundings of a given cell are represented by further cells. This MULTICELL type of approximation has been applied to a number of dissimilar problems, usually to obtain good multigroup spectra for data condensation where the expense of the eventual detailed spatial solution precludes the use in it of fine energy detail. The method is illustrated by application to simple examples of regular lattices but has been used in practice to represent complicated lattice cells including control absorbers and extended to approximate representations of whole reactors, where it forms a possible alternative to the buckling re-cycle methods hitherto used to adjust few-group data for environmental effects. (7 references) (auth)

7474 CALCULATION OF NEUTRON FLUX WITHIN WIDE ABSORBING RESONANCE REGIONS. Finkelstein, L. (Soreq Nuclear Research Centre, Yavne, Israel). pp 377-399 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

Determination of the neutron flux within wide resonance regions of strong—with respect to scattering—absorption presents difficulties. The usual analytical approximations become inapplicable while the second-order accuracy difference schemes of Nordheim and Rowlands were shown to diverge even for extremely small steps of integration. A short-range stability analysis of difference approximations is given and higher-order stable schemes of calculation are proposed. This allows larger integration steps and results in wide ranges of accuracy. An alternative approach to slowing-down calculations is also presented. It is based on a single heavy absorber, and extends the method to a mixture of several elements, including or excluding hydrogen. Though the computation formulas are not simple, the method has the merit of being accurate over a wide range and is therefore suitable for checking purposes. The slowing-down integral equation is converted to a one-parameter family of equations by, first, fixing the ratios of the collision intervals of the different elements of the mixture, and, secondly, considering a chosen collision interval as a free parameter. The sought solution is then expanded in a generalized power series of the free parameter, and an appropriate functional representation of the leading term is found and investigated. It turns out that the leading term itself depends on the parameter, and that its functional form is strongly influenced by presence of hydrogen. In a way similar to the case of a single absorber, a recursive system of relations for the expansion term is derived. When the initial condition, in form of a prescribed value of the slowing-down density, is imposed on the solution, the latter is uniquely determined. Usually, it turns out that two or three terms of the expansion give sufficient accuracy. (8 references) (auth)

7475 IMPROVED APPROACH FOR COUPLING A NUMERICAL INTEGRAL TRANSPORT METHOD WITH THE DIFFUSION METHOD IN A SLAB REACTOR. Elmeshad, Y. (Alexandria Univ., Egypt); Elmaghrabi, M. pp 407-422 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

A method is proposed and developed for treating two-region one-dimensional slab systems. One of the regions may be a fuel, the other region having the properties of a moderator or a reflector. Two-group formulation is used in the analysis. Integral transport theory is used and coupled to diffusion theory. The idea of using the integral transport method in the fuel region and of using the diffusion theory in the reflector was previously used with the fuel-reflector interface serving as coupling plane. In the method proposed the coupling between the integral transport and the diffusion theories takes place along a plane within the reflector region and away (by two or three mean free paths) from the fuel-reflector interface. This has the advantage of obviating the necessity of applying diffusion theory near the fuel-reflector interface. Thus a major source of error can be eliminated. The transfer of the coupling plane to the reflector region leads to the use of a two-region formulation of the two-group integral transport theory so that it becomes applicable to the fuel and reflector regions on both sides of the fuel-reflector interface. The resulting integral equations are solved numerically inside the fuel region and a part of the reflector. The analytical solution obtained by diffusion theory in the remaining part of the reflector is then matched, through the thermal and fast boundary conditions at the transport-diffusion interface, to the numerical transport solution. An iterative procedure is necessary for the matching process. (5 references) (auth)

7476 REFINEMENTS IN ACCURACY OF COARSE-MESH FINITE DIFFERENCE SOLUTION OF THE GROUP-DIFFUSION EQUATIONS. Henry, A. F. (Massachusetts Inst. of Tech., Cambridge). pp 447-471 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

Schemes for deriving few-group, coarse-mesh, diffusion theory descriptions for a reactor are described which will correctly predict criticality and gross power distributions. Methods are reviewed for determining "homogenized" few-group parameters which are constant over relatively large regions of the core and which account properly for the effect of local control rods, moderator concentrations and structural heterogeneities. Methods for obtaining accurate, coarse-mesh solutions of the resultant, few-group diffusion equations are discussed. Both semi-empirical schemes (based on subsidiary calculations or normalized to experiment) and higher-order difference solutions are described. (21 references) (auth)

7477 NUMERICAL SOLUTION OF THE NEUTRON DIFFUSION EQUATION IN THE PRESENCE OF CORNERS AND INTERFACES. Babuska, I.; Kellog, R. B. (Univ. of Maryland, College Park). pp 473-486 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

The one-group neutron diffusion equation in two space variables is considered in a region Ω of the plane. The region Ω is decomposed into a finite number of sub-regions, Ω_j, such that each Ω_j has constant material properties. The boundaries of Ω and Ω_j are assumed to be polygonal curves, consisting of a finite number of line segments which meet at a finite number of points, called the corners of the problem. The solutions of the diffusion equation will in general become singular at the various corners. The nature of the singularities is studied, and the implications of the singularities for the numerical solution of neutron diffusion problems are explored. It is shown that the existence of these singularities significantly lowers the accuracy (for small mesh spacing) of the approximate solutions of these problems, in comparison with the accuracy of the approximate solutions when there are no corners in the problem. The nature of the error caused by the singularities is analysed. Some numerical methods for solving the neutron diffusion equation, which use a variational formulation of the problem but take account of the singularities, are given. (20 references) (auth)

7478 ANISOTROPIC DIFFUSION CALCULATIONS IN GENERALIZED x,y-GEOMETRY. Daneri, A.; Michelini, M.; Toselli, G. (CEN, Bologna). pp 487-496 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

The diffusion approximation is reformulated, starting from a basis entirely different from the classical diffusion approach; there is no significant increase in computer time. (11 references) (auth)

7479 METHOD FOR THE NUMERICAL SOLUTION OF EIGENVALUE PROBLEMS IN DIFFUSION THEORY. Fladmark, G. E. (Institutt for Atomenergi, Kjeller, Norway). pp 497-507 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

A technique for updating the guessed eigenvalue during the Wielandt iterations is presented. This technique is based upon a theorem that the iterated eigenvalue calculated by the Wielandt algorithm after a certain number of iterations is increasing. This number of iterations is reduced when the dominance ratio is decreased. A numerical comparison of the Chebyshev extrapolated Power method and the Wielandt method with and without the updating technique is done by solving the one-dimensional neutron diffusion equation in two groups for a homogeneous slab and for a slab containing 10 different material compositions. The results show that the Wielandt method, by using the updating technique, has the following properties: it is faster than the other methods; neither the convergence nor the calculated eigenvalue depend on the initial estimated eigenvalue; it gives more correct results than the other methods when the same criteria of convergence are used. (5 references) (auth)

7480 SOME IMPROVEMENTS TO THE STABILITY AND THE CONVERGENCE OF THE REACTOR CODES DTF-IV, EXTERMINATOR AND TREPAN-TRIBU. Minsart, B. (CEN/SCK, Mol, Belgium); Quenon, J. pp 531-539 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

Most of the reactor computations at the CEN are based on the use of the DTF-IV and EXTERMINATOR codes, and a flexible triangular mesh multigroup diffusion code is required for the detailed core analysis of the BR2 reactor at the CEN and of the SNR prototype at BELGONUCLEAIRE. The first problems, run with the originally available versions of these codes, have indicated that all three were very time-consuming, at least for some types of problems, and revealed instability for particular thermal reactor calculations. Great effort has been directed towards the improvement of convergence and performance of these programs and, in the case of the triangular mesh code, a new version has been programmed. The main modifications which have been made and orders of magnitude of the gains achieved up to now are described. (9 references) (auth)

7481 VARIATIONAL FLUX SYNTHESIS APPROXIMATIONS. Stacey, W. M. Jr. (Argonne National Lab., IL). pp 561-589 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307, CONF-720104-.

Variational synthesis methods provide a systematic means for partitioning a multi-dimensional problem into a sequence of lower dimensional problems, thus allowing multi-dimensional solutions to be obtained with a degree of detail which would be uneconomical, if not impossible, with a direct solution. Such methods are particularly well suited for solving large problems on a relatively small computer. The applications of variational flux synthesis methods to solve the multigroup neutron diffusion equations are reviewed. Extended variational principles, which admit trial functions that both are discontinuous and fail to satisfy the boundary conditions of the physical problem, are generalized. A new variational principle, which contains all previous principles as special cases, is presented. The derivation of the single-channel spatial synthesis approximation from the variational principle, including initial, final, boundary, and interface conditions as well as the Euler equations, is reviewed. The apparent overdetermination of interface conditions which has been noted is discussed and shown to result from a previous failure to properly impose continuity requirements upon variations in the adjoint trial functions. Derivation of the more flexible multi-channel spatial synthesis approximation is discussed. A new generalized nodal approximation is derived from the discontinuous trial function variational formulation. This model allows the flux within each of several large regions to be expanded in known functions defined only over the region, thus providing a systematic procedure for coupling a global internodal calculation and detailed intranodal calculations. The use of a particular type of piecewise polynomial to modulate the functions normally employed in trial function expansions is introduced. The resulting modulated expansion functions are at the same time local in character (i.e. non-zero only over a limited domain) and continuous. Such modulated expansion functions are used to develop an overlapping multi-channel synthesis formalism which can directly employ the codes which have been developed for single-channel synthesis (troublesome surface integrals which appear in the conventional multi-channel formalism do not arise). Modulated expansion functions are used to develop an overlapping generalized nodal approximation which reduces in the case of a single, constant expansion function to a finite-element type approximation, illustrating that the latter are a subset of the former. Spectral synthesis approximations are derived. (53 references) (auth)

7482 FLUX SYNTHESIS METHODS VERSUS DIFFERENCE APPROXIMATION METHODS FOR THE EFFICIENT DETERMINATION OF NEUTRON FLUX DISTRIBUTIONS IN FAST AND THERMAL REACTORS. Froehlich, R. (Kernforschungszentrum, Karlsruhe, Ger.). pp 591-611 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

Flux synthesis methods are competing with difference approximation methods for the efficient calculation of flux and power distributions in large fast and thermal reactors. Both methods were used for various reactor types. The conclusions are the following: difference approximation methods are not well suited (on present-day computers) for large light-water reactors; flux synthesis methods have been applied to light water reactors with great success by skilled researchers, but a theoretical foundation is still missing. Difference approximation methods appear to be adequate for fast reactor calculations and should be preferred, even for three-dimensional calculations, because of their complete theoretical foundation and because an error analysis appears to be possible. Energy-synthesis (group collapsing) is not advisable or must be done very cautiously. For medium-sized computers, flux-synthesis methods could be a powerful tool in the hands of a very skilled and critical researcher. (26 references) (auth)

7483 FINITE-ELEMENT SOLUTION TECHNIQUE FOR NEUTRON TRANSPORT EQUATIONS (F_N APPROXIMATION). Ohnishi, T. (Atomic Energy Research Lab., Kawasaki, Japan). pp 629-638 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

.The finite-element solution technique is applied to the angular discretization of the neutron transport equation and a new type of approximation (F_N approximation) to the transport equation is constituted. The F_N equations are similar to discrete-ordinate equations, in the sense that the unknowns to be determined are the angular flux values for the finite number of discrete directions and that each equation has the same form in any order of approximation. These discrete-ordinate-like equations include the directional-coupling terms in addition to the scattering operator. It is well known that increased coupling of directions reduces ray effects. F_N equations are derived in which all discrete directions couple directly with each other. The order of approximation of this equation is the same as that of the P_N approximation. (12 references) (auth)

7484 ITERATIVE SOLUTIONS FOR THE FINITE-ELEMENT METHOD. Nakamura, S. (Ohio State Univ., Columbus); Ohnishi, T. pp 639-656 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

An iterative solution for the finite-element matrix equations has been studied with emphasis on a coarse-mesh acceleration scheme. The discussion is restricted to the triangular-finite-element method when applied to a two-dimensional diffusion equation in xy-geometry. As a basic iterative technique, a point successive-over-relaxation (SOR) scheme is adopted. A new scheme of coarse-mesh acceleration has been devised. This scheme is suitable for the finite-element method in the sense that a coarse-mesh equation can be formulated regardless of the location of nodal points. (7 references) (auth)

7485 NEW METHODS FOR SPACE-DEPENDENT KINETICS. Devooght, J.; Jaucot, A.; Machgeels, C. (Univ. Libre, Brussels). pp 657-673 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

To apply the method of reproducing kernels to the Cauchy equation, the numerical algorithms to solve time-independent and time-dependent reactor kinetics equations are studied. The solution is of mixed type: analytical for time and numerical for other variables. Many advantages over classical methods are to be noted: the accuracy can be improved by adding further terms to the series solutions, without any necessity to start the computation anew; the flux at one time may be evaluated at once without knowledge of the flux at previous times; instead of a large number of time steps, a dozen static problems must be solved; any approximate knowledge of the operator's spectrum may be incorporated in the solution. An error bound is obtained, and if, for instance, two eigenvalues are approximately known, the Laplace transform of the error of the amplitude of the k-th mode is given. The algorithm is accurate, fast and stable, and examples of application are given for pulsed neutron work in numerical assemblies and also for time-dependent thermalization. In the second part concerned with a time-dependent operator H(t), various algorithms for evaluating the exponent of a certain operator, i.e. the solution of the above-mentioned reactor kinetics equation is given. The reproducing kernel method is again used to interpolate the operator in order to reproduce exactly the first few eigenmodes. New Padé approximations sharing the same properties are proposed and compared with various recipes used for the integration of "stiff" equations. (12 references) (auth)

7486 PIECEWISE POLYNOMIAL APPROXIMATIONS FOR ONE- AND TWO-DIMENSIONAL SPACE-TIME KINETICS EQUATIONS. Hennart, J. P.; Jaucot, A.; Renda, V. (Univ., Brussels). pp 675-688 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307: CONF-720104-.

Numerical approximations of high order accuracy have been developed to solve the equations of diffusion type, which arise in the classical solution of space-time kinetics equations when implicit time differencing methods are used. These approximations are based on the variational formulation of the corresponding one- and two-dimensional diffusion equations: the classical Rayleigh-Ritz-Galerkin method is applied to the corresponding functional, which is minimized over a wide variety of finite-dimensional spaces of functions from the domain of the continuous variable. Among these latter, piecewise continuous functions or "spline" functions are particularly interesting because they give rise to algorithms very easy to handle, to high-order accuracies and finally to solutions which are especially compact. In one-dimensional geometry, two methods have been developed, which use, respectively, cubic and quintic spline trial functions: these functions built from a generalization of the classical Hermite interpolation method ensure continuity of the neutron flux and current at the internal boundaries as well as the external boundary conditions. Using the diffusion equation to eliminate one of the parameters used, the second method requires the same amount of arithmetic calculation as the first one; moreover, the reported accuracies are in accordance with the theoretical estimates, i.e., O (h^4) and O (h^6), respectively. In two-dimensional geometry, schemes using global and local bases of bicubic splines have been considered. The local ones have the great advantage of giving rise to systems of algebraic equations which exhibit a band structure easy to handle numerically. These methods give accuracies of O $(h_x^4 + h_y^4)$. That formulation has been used in connection with the classical space-time kinetics, and a code has been written in one-dimensional geometry to solve the corresponding equations: this code is far more accurate and faster than the classical codes with the usual space-differencing techniques. (11 references) (auth)

7487 FULLY IMPLICIT ALTERNATING DIRECTION METHOD APPLIED TO THE ENERGY- AND TIME-DEPENDENT NEUTRON DIFFUSION EQUATION. Birkhofer, A.; Werner, W. (Laboratorium fuer Reaktorregelung und Anlagensicherung, Garching, Ger.). pp 689-696 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

A novel ADI method, which is implicit also with respect to coupling terms, is presented. Because of the implicitly treated coupling terms, time differences are always centered, thus yielding essentially smaller discretization errors than conventional ADI or ADE methods, without much increase of computing time per time-step. Since considerably larger time steps are permitted and computing per time is not much larger than for the two-layer explicit method, the presented method compares very favorably with other finite difference methods. Besides the application to dynamic problems, the method has been used very successfully for the computation of stationary solutions of the multigroup diffusion equation. It is used analogously to the process described by Werner and Birkhofer. In this process, the solution of an eigenvalue problem is computed as the asymptotic solution of a dynamic problem, with successive corrections of a quantity which finally becomes the sought eigenvalue. Since the described ADI method allows to advance the intermediate solutions with large time steps, only about 20 cycles are necessary to compute the eigenvalue of a medium-size problem to six decimal places. Presumably, this figure will not change considerably for larger problems since essentially the algorithm describes the physical diffusion phenomena from the prescribed initial data to the desired asymptotic solution. Numerical examples for stationary and dynamic calculations are presented. (5 references) (auth)

7488 STATUS OF THE MONTE CARLO DEVELOPMENT. Schmidt, F. A. R. (Univ., Stuttgart). pp 699-719 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

Information is presented concerning the Monte Carlo method; the biased transport equation; choice of estimators; importance biasing; problem splitting; Monte Carlo simulation; Monte Carlo simulation as sum of simulations of single processes; claims to modern Monte Carlo programs; Monte Carlo codes; limitations of the Monte Carlo method; statistical error; calculation time; only integral answers; and range of applicability of Monte Carlo. (21 references) (auth)

7489 THERMAL PHYSICS PARAMETERS OF HETEROGENEOUS WATER MODERATED REACTOR LATTICES USING ENDF/B DATA AND THEIR COMPARISON WITH MONTE CARLO ESTIMATES. Rothenstein, W.; Eisenberg, J. (Technion-Israel Inst. of Tech., Haifa). pp 721-734 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

Nuclear data currently available on magnetic tapes provide a means of evaluating the physics parameters of reactor lattice for the entire neutron energy spectrum when appropriate reactor physics codes are used. In 1969 a detailed analysis of light- and heavy-water-moderated lattices was made with ENDF/B data and the HAMMER code system at Brookhaven National Laboratory. The results revealed discrepancies of the order of 2 to nearly 4 per cent in k_{eff} when experimental buckling values were used to characterize the leakage. k_{eff} was less than unity in every case. At BNL the Monte-Carlo method has been frequently employed as a means of comparison with calculations free from approximations. In particular, the resonance integrals for ^{235}U and ^{238}U as obtained by the Nordheim procedure were found to be too large and appropriate corrections were made in the HAMMER calculations. These reduced the discrepancies between theory and experiment but did not eliminate them entirely. A thermal Monte-Carlo code was recently written and used to test the accuracy of the reaction rates and leakages obtained by THERMOS in HAMMER. THERMOS is based on spectrum calculations using isotropic scattering kernels. For the evaluation of the diffusion coefficients and diffusion areas the first-order moment of the kernels is also taken into account. In a Monte-Carlo code there is no need for such limitations. In fact, provision was made to use an optional number of Legendre moments of the scattering kernel as obtained from the ENDF/B data for $S(\alpha, \beta, T)$ with the FLANGE-II code. Monte Carlo-calculations were made principally for D_2O lattices in which the thermal leakage is considerable. In limited machine times (up to about 10 minutes per lattice on the IBM 370/165 computer) good accuracy resulted for the principal reaction rates, the errors being less than one half per cent on the fifty per cent confidence level. They agreed very well with the HAMMER values. The diffusion areas showed greater inaccuracies up to about 2 per cent. There was a trend for its value to increase when the number of Legendre moments of the scattering kernel used was increased. The values of L^2 were a few per cent less than those obtained by HAMMER except for the largest rod sizes and the loosest lattices. This leads to a further small increase in k_{eff} in addition to that arising from the corrections of the resonance integrals. (9 references) (auth)

7490 CAPABILITIES OF THE MORSE MULTIGROUP MONTE CARLO CODE IN SOLVING REACTOR EIGENVALUE PROBLEMS. Burgart, C. E. (Oak Ridge National Lab., TN). pp 735-746 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

MORSE utilizes multi-energy group cross-sections identical to those used by several discrete-ordinates codes. Thermal upscattering may be included. Legendre polynomial expansions of the angular distributions for each group-to-group transfer are utilized when anisotropic scattering is considered. A general geometry module, capable of describing any combination of quadratic surfaces as well as special geometry modules for simplified slab, cylindrical, or spherical systems are available. Albedo boundary conditions may be applied at any surfaces. Calculations may be performed in the forward as well as adjoint mode. Two additional features are of particular interest in reactor calculations. First is the "fictitious-scattering" method of choosing path lengths. Using this method, pseudo-collision sites are chosen using the maximum total cross-section in the system. A rejection technique based on the ratio of the actual total cross-section at the pseudo-collision to the maximum cross-section is utilized to determine if this is a real collision. If the test fails, a new pseudo-collision site is chosen. The "fictitious-scattering" method avoids much of the geometry tracking usually encountered in complex reactor calculations. Thus, the calculation time does not increase proportionately to the geometric detail. Another feature of interest is the "point cross-section" option. MORSE can utilize "point" total, scattering, and fission cross-sections in selecting path lengths, in non-absorption weighting, and in producing fission neutrons. These cross-sections are defined at numerous energy points in a variable supergroup-subgroup structure. The energy degradation and outgoing direction are chosen as in a conventional MORSE calculation. However, for the purpose of cross-section lookup, the energy within a given multigroup is chosen from a constant frequency function. This point cross-section option allows considerably more detail in the cross-sections to be utilized with relatively little penalty in computer core storage. Some of the disadvantages of multigroup cross-section weighting may thus be avoided. The quantities routinely calculated for reactor eigenvalue problems include, in addition to k_{eff}, the mean time to birth and the mean time to death. Average reaction rates in specified spatial regions may also be determined. These quantities have been calculated for several critical configurations, and the usefulness of some of the above capabilities are discussed. (26 references) (auth)

7491 ELF NEUTRON PROGRAM. Gervaise, F. (CEN, Fontenay-aux-Roses, France). pp 749-762 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972). (In French).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

The ELF program deals with the polykinetic propagation of neutrons by a Monte Carlo method in spherical or cylindrical geometry with the possibility of reflection on an external circular or polygonal contour. It has been used for the study of (a) the propagation of 14.7 MeV neutrons in uranium (the effect of fast fission); (b) fast neutron fluxes, an exact knowledge of which is required for the calculation of the ionization occurring in the lattices of graphite-moderated, gas-cooled reactors, the damage produced in a heavy-water reactor lattice, and the spectral index (Ni, Cu, Rh, P, etc.) in irradiation reactors; (c) the resonance escape probability of a light-water reactor cell in resonance regions. The program makes use of UKNDF evaluation data from the United Kingdom. Cross-sections are treated point by point, with linear interpolation. Using a considerable amount of nuclear data (several thousand points to describe a cross-section), the ELF program is so designed that it carries out calculations in an acceptable time while occupying a number of memories compatible with medium-sized computers. One version of it has been reduced to a space requirement of 120 K for an IBM 360/40 computer at the request of foreign users. The program determines the important functions by iteration and applies exponential transformation. The results are printed out on tape and fed into an auxiliary program, which analyses the variation of the mean, the variance and the reliability (W test) as a function of the number of samples. A version also exists for dealing with gamma radiation. (auth)

7492 NEUTRON FLUXES IN FINITE HOMOGENEOUS MEDIA BY THE SEMI-ANALYTIC MONTE CARLO METHOD. Jain, V. K.; Lawande, S. V. (Bhabha Atomic Research Centre, Bombay). pp 769-782 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

The "semi-analytic" Monte-Carlo method can be used to compute neutron density functions at prescribed positions and energies in convex bodies of homogeneous material. The method essentially involves a random sampling of the flight directions and energies of the neutrons coupled with an analytic treatment of the spatial distribution of collisions. The numerical results obtained on a CDC-3600 (32 K memory) computer for neutron slowing-down fluxes in finite homogeneous media with slab and rectangular geometry are presented. Comparison with some experimental results is also given. (11 references) (auth)

7493 SPECTRUM OF NEUTRONS EMERGING FROM A HYDROGENOUS MATERIAL USING THE MONTE CARLO METHOD AND ITS COMPARISON WITH THE FINITE-DIFFERENCE METHOD. Kapil, S. K.; Balakrishnan, K. (Bhabha Atomic Research Centre, Bombay). pp 783-796 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

Hydrogenous materials are often interposed between a fast-neutron beam and the neutron counters to increase their detection efficiency. A Monte-Carlo study is made to determine the optimum thickness of a rectangular slab of hydrogenous moderator. The Monte-Carlo results, with the scattering anisotropy in the laboratory system taken into account exactly, are compared with finite-difference calculations. Thus the limits on the validity of the usual finite-difference calculations for the leakage from a hydrogenous material are pointed out. (8 references) (auth)

7494 REACTOR CALCULATIONS BY AN EFFICIENT MONTE CARLO METHOD. Lu, P. K.; Bull, R. (Univ. of Missouri, Columbia). pp 795-803 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). STI/PUB-307; CONF-720104-.

Analytical methods for reactor analysis have been confined primarily to multigroup neutron diffusion and transport theory codes. The assembly is typically modelled in spherical geometry, and a one-dimensional calculation is performed. The Monte-Carlo method is potentially the most accurate, but it has been avoided because the computer time consumed is often excessive for calculations that do not require detailed analysis as in shielding problems. A track-length-estimator Monte-Carlo approach has been adopted; the method easily yields a low variance in a large variety of reactor regions because the neutron flux is recorded for each flight path. In spherical geometry, a uniform statistical error may be obtained in each spatial region and the computation time is reduced if a one-dimensional track length estimator is used. The complexity of the one-dimensional calculation is decreased by replacing the track length with the radial projection of the track length. A one-dimensional, 10-spatial region Monte-Carlo calculation was performed in spherical geometry to determine the critical mass, power distribution and 19-group neutron flux distributions in a mock-up gas-core reactor. A gas-core reactor offers a rigid test for a Monte-Carlo method because of the large size and low absorption of the reactor. The mock-up reactor (cylindrical geometry) was used for experimental investigations performed by General Electric Company for NASA-Lewis Research Center. The results obtained for k_{eff} was 1.021 compared to an experimental value of 1.02 with an absolute statistical error of about 1% based on 2000 histories. The neutron-flux distributions are in excellent agreement with one-dimensional, spherical S_4, TDSN calculations. The one-dimensional track-length-estimator Monte-Carlo method has been shown to be practical for reactor calculations using small computers since the computation time on an IBM 360/50 was only a few minutes. (auth)

7495 TWO-GROUP DIFFUSION CONSTANTS OF FAST NEUTRONS FROM THE REACTOR IN WATER MEDIUM WITH HOLLOW CYLINDRIC CANALS. Antonov, N.; Damyanov, D.; Troshev, T.; Khristov, V. Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk.; 22: 81-87(1972). (In Russian).

The fast neutrons passage from the reactor through a heterogeneous water medium with hollow cylindric canals are observed in two energetic groups, one with energy over 3 MeV and the other with energy of 1.44 MeV to 3 MeV. The leading section method for neutron beams is applied in the diffusion experiments in heterogeneous medium, permitting the relaxation length determination for the fast neutrons with energy over 3 MeV in both directions of diffusion. According to this method for the relaxation lengths the values $\lambda_{\|} \approx \lambda_{\perp} \approx 16.7$ cm were found. This measured value is a little greater than the calculated mean homogenized value of 14.3 cm, found in accordance with Bierens theory. The experimental values of relaxation length (16.7 cm) can be interpreted in the Bierens terminology as a diffusion extension. The measured diffusion lengths, diffusion extensions, and the anisotropic coefficient in the exponential method concur with values for these constants derived with the Bierens theory. (auth)

7496 SPECTRA AND SPECTRAL INDICES OF THERMAL NEUTRONS IN HETEROGENEOUS WATER LATTICES. Khristov, V.; Stanolov, A.; Ilieva, K. Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk.; 22: 55-63(1972). (In Russian).

The energetic distribution of thermal neutrons in heterogeneous water lattices is investigated in two ways: the first is an aluminum tube lattice filled with PbO(B), in distilled water with tube radius 0.5 cm and lattice step 1.8 cm, which makes it equivalent to a uranium water lattice of the reactor IRT; the second represents a water lattice of hollow aluminum tubes with the same step and radius of tubes. The lattices are placed in the IRT reactor reflector and thin foils from dysprosium, lutetium, europium, gold, copper, and indium are placed in the lattice. The determination of spectra from the foil activation was made by polynomial representation of searched energetic distribution, and tested by an approximate distribution taken in pure water according to Nelkin's model. Satisfactory results of spectral indices T and λ were found with which the spectral distribution of thermal and epithermal neutrons can be approximated with good precision. (auth)

Reactor Components and Accessories

Refer also to abstracts 5476, 5481, 6207, 6277, 6340, 7211, and 7628.

7497 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Burylo, P. S.; Hughes, D. J. (to English Electric Co. Ltd.). British Patent 1,306,037. 7 Feb 1973. Filed date 21 Jan 1971. 8p.

Reference is made to reactors incorporating turbomachinery housed in penetrations in the pressure vessel wall and to means of closure of the penetrations housing heat exchangers of the turbo-machinery. Such penetrations will normally contain gas, such as He at high temperature and pressure, and in order to prevent escape of this gas to the atmosphere it is necessary that the penetrations be sealed. Conventionally the penetrations are provided with a primary closure device that provides a gas-tight seal, and a secondary closure device that on failure of the primary device will limit the escape of gas to acceptable proportions. In the arrangement described, the secondary closure device is provided by a water box of the heat exchanger. The penetration is provided at its end with a cylindrical metal liner with the primary closure device, in the form of a dished metal plate. The water box extends across the bore of the liner of the primary closure device. The water box is provided with a pair of plates sealed together at their edges, with a partition separating the space between them into a feed chamber and a return chamber. (UK)

7498 PRESSURE TANK FOR A NUCLEAR REACTOR. Lenschow, R. (to Univ. of Trondheim). Norwegian Patent 126,446. 27 Feb 1969. 9p. (In Norwegian).

Due to the problems arising in prestressing concrete pressure vessels for large reactors by means of cables in the concrete tank walls, it is proposed to place the tank in a concrete lined pit in rock, or other pressure resistant material, the outside of the tank having a number of ribs. Membrane jacks are then placed between these ribs and the wall of the pit and provide means for prestressing the concrete pressure vessel. The membrane jacks have two, or more, compartments which may be pressurized independently. Wedges may be driven in between the jacks to maintain the prestressing while the jacks are depressurized, or a hard setting material injected between, or in one compartment of, the jacks. (NO)

7499 DEVICE FOR REGULATING A FLUID FLOW AND NUCLEAR REACTOR FITTED OUT WITH SUCH A DEVICE. Demaret, J. P.; Gilly, L.; Melon, R. Belgian Patent 752,429. 23 Jun 1970.

A device is described for regulating the fluid flow in a circuit consisting of a high-pressure chamber, a chamber at reduced pressure, and a reservoir at reference pressure. One or more primary devices for regulation flow cross section as well as a charge or one or more secondary devices for regulation of the flow cross section in series with it or the primary device for regulation of the flow cross section are used. Each of the primary devices for the regulation of flow cross section consists of a valve or orifice closure and an assembly of two pistons for controlling the position of the orifice closure. The two pistons are arranged in such a manner that the pressure in the chambers at high pressure and at reduced pressure exert antagonistic forces on the two pistons. (BE)

7500 CORE LOADING AND REACTIVITY MEASURING SYSTEM. Corte, E. A.; Brown, J. R. (Gulf General Atomic Inc., San Diego, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 627-632(Feb 1973).

A novel and versatile core loading and reactivity measuring system has been designed and reactor tested. The most significant features of the system are the use of a pulsed neutron source for in-core measurements and an on-line reactivity computer coupled with statistical-type measuring channels using a combined counting/Campbelling technique for out-of-core measurements. Advantages of these new measuring techniques and the system hardware are described. (auth)

7501 APPLICATION OF MINI-COMPUTERS TO SAFETY SYSTEMS. Damon, D. L. (Bechtel Corp., San Francisco). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 753-760(Feb 1973).

The potential use of dedicated self-checking mini-computers to reduce the operating manpower requirements to conduct testing, to minimize the test intervals and to enhance overall safety system reliability is discussed. (3 references) (auth)

Reactor Fuels

Refer also to abstracts 5480, 6113, 6128, 6130–6133, 6138, 6155, 6170, 6383, and 6386.

7502 (BNWL-tr-82) IRRADIATION OF URANIUM OXIDE IN STRONG CLADDING. Effect of Initial Diametral Gap on Overall Behavior. Program CC-7, 1st and 2nd Sections. Janvier, J.-C.; de Bernardy de Sigoyer, B.; Delmas, R. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 15 May 1973. Translation by E. R. Appleby of CEA-R-3358. 30p. Dep. NTIS $3.50.

The behavior of sintered UO_2 prepared by the procedures in force in France have been studied under power conditions a little more severe than those expected at maximum power in the EL-4 reactor. Sixteen experimental elements with very thick claddings, including a device for continuous measurement of the power, were irradiated at two burnups around 3000 and 6000 MWD/t; the initial dimensional gaps were selected so that the fuel was either free to expand, or under compression by the cladding. The results of post-irradiation examinations are presented. (auth)

7503 (CONF-730330-1) NUCLEAR FUEL CYCLE. Brooksbank, R. E. (Oak Ridge National Lab., Tenn.). 1973. 41p. Dep. NTIS $4.25.

From Radiological Health Personnel conference; Oak Ridge, Tennessee, USA (28 Mar 1973).

The basic principles involved in a generalized fuel cycle are given. Regulatory means used to control the operational areas of the fuel cycle and to protect the public health and safety are reviewed. The technical and manpower problems of the nuclear industry are described. (FS)

7504 (GEAP-12268) TRANSPORT AND REACTION OF Cs, Te, I, AND Mo WITH FAST REACTOR FUEL AND STAINLESS STEEL CLADDING. I. Aitken, E. A.; Evans, S. K.; Rubin, B. F.; Ludlow, T. E. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Nov 1972. Contract AT(04-3)-893. 58p. Dep. NTIS $5.45.

Type-316 stainless steel fuel pins containing fuel at a known stoichiometry and additives of cesium oxide, tellurium, iodine, and molybdenum were heat treated in a temperature gradient between 550 and 1100°C for 100 hours. The distribution of each additive along the temperature profile was measured with the aid of tracer isotopes. The reactions of the fission products with the fuel and cladding were determined by metallographic examination. Cesium was found to react with iodine, tellurium, and fuel. The cesium-fuel reaction was dependent on the stoichiometry of the fuel. Tellurium reacted with the fuel in the presence or absence of cesium. However, the distribution of tellurium was affected by Cs-to-Te ratio. Intergranular attack of the stainless steel occurred between 750 and 950° when tellurium was present and the fuel was stoichiometric. Cesium oxide caused intergranular attack when the oxygen potential was higher than the potential, characteristic of stoichiometric fuel. Iodine and molybdenum additions with or without cesium did not induce intergranular attack. If the fuel was hypostoichiometric, none of the additives produced intergranular attack. The implication of these data on the nature and mechanism of cladding attack in irradiated mixed oxide fuels is discussed. (auth)

7505 (N-73-11707) NEUTRON RADIATION CHARACTERISTICS OF PLUTONIUM DIOXIDE FUEL. Taherzadeh, M. (Jet Propulsion Lab., Pasadena, Calif.). 1 Dec 1972. Contract NAS7-100. 23p. (NASA-CR-129098; JPL-TR-32-1555(Rev. 1)). NTIS.

The major sources of neutrons from plutonium dioxide nuclear fuel are considered in detail. These sources include spontaneous fission of several of the Pu isotopes, reactions with low Z impurities in the fuel, and reactions with ^{18}O. For spontaneous fission neutrons a value of (1.95 ± 0.07) × 1,000 n/s/q PuO$_2$ is obtained. The neutron yield from (alpha, neutron) reactions with oxygen is calculated by integrating the reaction rate equation over all alpha particle energies and all center-of-mass angles. The results indicate a neutron emission rate of (1.42 ± 0.32) × 10,000 n/s/q PuO$_2$. The neutron yield from (alpha, neutron) reactions with low Z impurities in the fuel is presented in tabular form for one part per million of each impurity. The total neutron flux emitted from a particular fuel geometry is estimated by adding the neutron yield due to the induced fission to the other neutron sources. (auth)

7506 (RCN-179) INFLUENCE OF ECCENTRIC ASSEMBLY CLEARANCE ON THE PERFORMANCE OF INDIRECTLY HEATED PINS. Vonka, V.; de Jong, H. D. (Reactor Centrum Nederland, Petten). Jan 1973. 25p. Dep. NTIS (U. S. Sales Only) $3.25.

The asymmetric thermal performance of electrically heated pins for out-of-pile simulation of sodium cooled fuel bundles is investigated. Some results of calculations performed on RCN-type heaters are given. The eccentricity of the assembly clearance and the axially asymmetric arrangement of the heaters in the cooling channels are assumed to be the only causes of the asymmetric performance. It is demonstrated that the latter effect is smaller and practically overshadowed by the first one, especially in the case of a large assembly clearance. In this case a steep circumferential variation of both the power delivered from the heater to sodium and the temperature inside the heater assembly can be predicted. (NL)

7507 (SRARI-P-177) STRUCTURE FORMATION AND GAS RELEASE IN UO$_2$ FUEL ELEMENTS. Samsonov, B. V.; Sidorov, V. V.; Spiridonov, Yu. G. (Scientific Research Inst. of Atomic Reactors, Dimitrovgrad (USSR)). 1972. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A structure formation process in the UO$_2$ fuel core during the reactor operation is considered. It is shown that the limiting stage for the structure formation process is the UO$_2$ vaporization and condensation process rather than the diffusion of its molecules through a gas medium in a pore. The relation between the formation of the core structure and fission gas release into the fuel element can is established. The supposition on the kinetics of the fission gas release from UO$_2$ does not contradict the experimental data. The calculated values are in agreement with the experiment. (auth)

7508 (WASH-1196(73)) SURVEY OF UNITED STATES URANIUM MARKETING ACTIVITY. (Division of Production and Materials Management (AEC), Washington, D. C.). Apr 1973. 20p. Dep. NTIS $4.00.

Information was received from 57 utilities with reactor projects, 5 reactor manufacturers, and 19 uranium producers or companies with definite plans for future uranium production including essentially all companies involved in the nuclear industry. From this a virtually complete status report is made on uranium delivery commitments, fuel cycle plans, and unfilled requirements. The data cover 156 civilian nuclear power reactors (privately and publicly owned) in operation, under construction, or for which orders have been placed, having a total capacity of 141,000 megawatts electric (MW(e)). The reactors covered are listed. (auth)

7509 NUCLEAR REACTOR FUEL ELEMENT ASSEMBLY. Lloyd, C. G. (to United Kingdom Atomic Energy Authority). British Patent 1,306,806. 14 Feb 1973. Filed date 22 Oct 1969. 4p.

Reference is made to mechanical couplings for interconnecting parts of fuel element assemblies. During servicing of a reactor it is desirable to be able to lift a complete fuel element assembly from the core, substitute a new full element section for the old section, and then replace the complete assembly in the core. Manipulation to release couplings may present difficulties since it must be performed by remote means, and without dropping or otherwise causing damage to the fuel element. The releasable coupling described comprises a ball latch device, the balls being retained in latching engagement by a displaceable sleeve constituted by the neutron shield member of the fuel element assembly. The coupling is arranged so that between locked and unlocked conditions there is an intermediate condition wherein the sections are able to move from their locked positions only in telescopic contraction. Construction details are given. (UK)

7510 METHODS USED IN THE DESIGN OF FUEL ASSEMBLIES: 2D Sn CALCULATIONS. Stamm'ler, R. J. J. (ASEA-ATOM, Vaesteras, Sweden). pp 3-49 of Numerical Reactor Calculations. Vienna; International Atomic Energy Agency (1972).

From seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972). See STI/PUB-307; CONF-720104-.

A brief survey is given of the flow of calculations in thermal-reactor-physics design. One aspect of these calculations is further investigated, namely, 2D xy-calculations on fuel assemblies. It is shown that diffusion theory is not accurate enough, while collision-probability methods are too costly for design studies. This leaves the Sn method, and a special S4 code, SFINX, is described. The various approximations inherent in this code are briefly discussed and found to be satisfactory. They are: the S4 approximation itself; the use of isotropically reflecting boundaries; the use of isotropic scattering combined with the transport correction; and the pin-cell homogenization used to provide input data for 2D assembly codes. Very short computation times were achieved, even for 12-group calculations. This has been possible by paying special attention to the central S4 algorithm, and by a careful choice of the acceleration techniques used in inner and outer iterations. (54 references) (auth)

Reactor Control Systems

Refer also to abstracts 5655, 5696, 5697, 7347, 7348, and 7613.

7511 (AEEW-R-843) DYADIC APPROXIMATION METHOD FOR MULTIVARIABLE CONTROL SYSTEMS ANALYSIS WITH A NUCLEAR REACTOR SPATIAL CONTROL APPLICATION. Owens, D. H. (Atomic Energy Establishment, Winfrith (England)). Jan 1973. 33p. Dep. NTIS (U. S. Sales Only) $3.75.

A method is developed for the approximation of a given plant transfer function matrix H(s) by a transfer function matrix of dyadic form. An application for the method is suggested in the stabilization of the radial spatial modes of a thermal nuclear power reactor. (auth)

7512 (CEA-CONF-2163) MINICALCULATOR FOR NEUTRON MEASUREMENTS IN A NUCLEAR REACTOR. Jover, P. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1973. 14p. (In French). (CONF-730108-4). Dep. NTIS (U. S. Sales Only).

From symposium on Nuclear Power Plant Control and Instrumentation; Prague, Czechoslovakia (22 Jan 1973).

Numerical calculators have been used for some time for the management of nuclear reactors. In the majority of cases, the calculator is used for the processing of measurement data and alarm signals, the emission of messages, and the analysis of incidents. In some cases, the calculator participates in a more or less direct fashion in the control so as to improve the performance of the center. However, up to the present, the different parameters which characterize the operation of the core, such as the neutron power, the period, and the reactivity, have been measured with analog equipment. Because of the recent appearance of low price minicalculators of great flexibility, it was judged opportune to construct experimental equipment, using standard materials connected with a minicalculator, for neutron control of a reactor. A description is given of the different parts of the experimental equipment constructed at Saclay and installed in a low-power reactor. The results of the experience after several months of use are reported. (tr-auth)

7513 (ORNL-4877) BORON CONCENTRATION GRADIENT FOR IMPROVED THERMAL REACTOR PERFORMANCE OF BORON STAINLESS STEEL CONTROL RODS. Beaver, R. J.; Richt, A. E. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 46p. Dep. NTIS $3.00.

The performance of conventional 2 to 3 wt % ^{10}B-stainless steel alloys and powder dispersions is limited in thermal reactors because the ^{10}B(n,α) reactions are localized at and near the surface of the material. Significant swelling occurs after a relatively short exposure, and additional exposure damages the microstructure in the localized regions. A symmetrical boron concentration gradient in which the ^{10}B is low at the surface and increases in a prescribed manner to higher concentrations below the surface increased the performance capability of boron-stainless steel neutron absorbers. This method was exploited in the 10-MW SM-1 Reactor. The neutron absorber section assembly of the control rod is a rectangular parallelepiped consisting of four 0.090-in.-thick plates clad with 0.032-in.-thick austenitic stainless steel. The ^{10}B concentration was set as 1 wt % ^{10}B at the surface of the plate and in a programmed manner increased to 3 wt % ^{10}B 0.024 in. below the surface. For an intended fluence of 4.3×10^{20} neutrons/cm^2 (thermal) this specific boron concentration gradient extends the ^{10}B consumption without damaging effects in any volume increment to 36×10^{20} atoms/cm^3 (maximum). Thus, the allowable average ^{10}B burnup for the onset of swelling can be increased from 5 at.%, the limit for conventional dispersions, to 20 at.%. Postirradiation examination of a boron-gradient neutron absorber, which contained ^{10}B dispersed in type 200 austenitic stainless steel and was used for six years in the central region of the active lattice of this SM-1 Reactor, confirmed this improvement. (auth)

7514 STABILITY ANALYSIS OF A REACTOR CONTROL SYSTEM BY THE TSYPKIN LOCUS METHOD. Tsouri, N.; Rootenberg, J.; Lidofsky, L. J. (Columbia Univ., New York). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 649-660(Feb 1973).

The Tsypkin Locus method is extended to investigate the stability and the existence of a possible limit-cycle in the control system of a large (coupled-core) reactor. The investigation includes the effect of different phase shifts between two adjacent sections of the core. Two examples are given and a comparison between the Describing Function approach and the more accurate Tsypkin Locus method is made. (auth)

7515 DESIGN OF AN OPTIMAL NONINTERACTING CONTROL SYSTEM FOR A COUPLED CORE NUCLEAR REACTOR. Raju, G. V. S.; Fadra, U. G. (Ohio Univ., Athens). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 668-674 (Feb 1973).

A procedure is presented to design an optimal noninteracting control system for a coupled core nuclear reactor. The optimal feedback coefficients are computed by minimizing a quadratic performance index. Nuclear reactors have inaccessible state variables corresponding to concentration of delayed neutrons. A method is given to reconstruct these inaccessible state variables which are essential for feedback to obtain noninteracting control system. (9 references) (auth)

7516 EXPERIENCE WITH PROCESS CONTROL COMPUTERS IN THE CANADIAN NUCLEAR POWER PROGRAM. Smith, J. E. (Atomic Energy of Canada Ltd., Sheridan Park, Ont.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 724-735(Feb 1973).

The Pickering and Bruce G. S. computer control systems are described. The operating experience at Pickering G. S. and the design of the Bruce G. S. system are discussed. (auth)

7517 COMPUTERS ON WESTINGHOUSE PWR's: FORESIGHT AND HINDSIGHT. Gallagher, J. M. Jr.; Selmeczy, J. G. (Westinghouse Electric Corp., Pittsburgh). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 736-739(Feb 1973).

Early in 1965 the Westinghouse PWR Division set up a task force of engineering personnel from the key systems engineering activities with the assignment to develop a recommended set of application programs for an on-line digital computer system. These application programs established the basis for the incorporation of a digital computer system as part of the standard NSSS package. The ground rules given to the task force for the development of the application programs, the programs which evolved from their work, and the operating experience from several plants which have used the programs are reviewed. Some of the areas where the computer can be used more effectively or where the computer functions can be extended to in order to enhance plant performance and availability are discussed. (auth)

7518 COMPUTER IN BWR OPERATIONS: PRESENT AND FUTURE. Sweet, W. B.; Conklin, D. R. (General Electric Co., San Jose, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 740-744(Feb 1973).

The current General Electric Boiling Water Reactor process computer is a conventionally architectured, medium sized, monolithic system based upon the GE-PAC 4010. The system performs scan, log, and alarm functions, as well as some rather complicated nuclear steam supply and turbine generator performance calculations. However, over the years, the G. E. system designers in San Jose have become aware of both the limitations of the monolithic architecture as applied to the rapidly growing nuclear applications as well as the recent tremendous advances in computer hardware technology. What has emerged is the concept of a distributed computer control system primarily designed for the G. E. BWR, but also ideally suited for other applications. Built around a high speed common data base memory, the distributed system yields a giant improvement in terms of overall computer system modularity, software simplicity, versatility, price/performance ratio, availability, and functional capability. (auth)

7519 ON LINE COMPUTER SYSTEM FOR THE EL4 NUCLEAR POWER PLANT. Chapelot, A. B.; Jego, H. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 745-746 (Feb 1973).

The experience and the operation results of computer processing at the EL4 heavy water power plant are described. (auth)

7520 SAFETY AND PROCESS COMPUTERS IN PHENIX NUCLEAR POWER PLANT. Chapelot, A. B.; Grisollet, J.; Ranavolo, J. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 747-752(Feb 1973).

The use of computers in the PHENIX fast breeder power plant is described. Two safety computers were designed for fuel element plugging detection in order to initiate reactor scram. Two computers were also designed for plant data processing, to develop adequate computer operation procedures and man-machine communications, and to classify the data processes. (auth)

7521 REMOTE MULTIPLEXING FOR DIGITAL SYSTEMS IN NUCLEAR POWER PLANTS. Dye, M. M. (Gulf General Atomic Co., San Diego, CA); Fling, J.; Winarski, C. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 761-766(Feb 1973).

The application of a Remote Multiplexing System specifically designed for use in nuclear power plants to greatly reduce the amount of instrumentation and control wiring is described. Adapting a plant to direct digital control at some future date is also discussed. The criteria for such a system are discussed. Extreme care in system and equipment design is required to provide the reliability, environmental durability, insensitivity to electrical transients and immunity to common mode failure. (4 references) (auth)

7522 ADVANCED CONTROL ROOMS FOR BOILING WATER REACTORS: THE NUCLENET CONTROL COMPLEX. Stokes, H. (Pennsylvania Power and Light Co., Allentown); Gummersall, S.; Johnson, R. L. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 786-800(Feb 1973).

The first generation of advanced control systems is described. The next generation of designs is previewed. The design criteria used are detailed. (auth)

Nuclear Power Plant Economics

Refer also to abstracts 5516, 7289, 7291, 7296, and 7304.

7523 (MRR-93) COMPUTER PROGRAMS FOR SYSTEMS RELIABILITY ANALYSIS OF NUCLEAR REACTORS. Dressler, E. (Technische Universitaet Muenchen, Garching (West Germany). Laboratorium fuer Reaktorregelung und Anlagensicherung). Nov 1971. 32p. (In German). INIS.

A survey of methods and capabilities of computer programs used in Germany for reactor systems reliability calculations is presented. As far as foreign programs were available, these are also considered. (INIS)

7524 NUCLEAR AND CONVENTIONAL THERMAL POWER PLANTS. Levai, A. (Technical Univ., Budapest). Period. Polytech., Mech. Eng.; 16: No. 4, 331-341(1972). (In German).

The following subjects are discussed: fundamentals and layouts (conventional thermal unit, nuclear thermal unit); comparative economics of conventional and nuclear thermal power plants; prospects of remote heat supply from thermal power plants; and applications. So far, nuclear power plants have been used in cooperative electric power systems, but the trend is toward centralized communal heating of urban areas as well. Economic considerations compel development of coupled heating and electric power generation with modern condensation plants which combine the desirable size and operational safety. An example is presented involving an area with 250,000 residential units with a peak thermal demand of 2000 Gcal/hr. (JPRS)

Reactor Fuel Cycle Economics

Refer also to abstract 7273.

7525 REVIEW OF PLUTONIUM UTILIZATION IN THERMAL REACTORS. Schmid, L. C. (Battelle Pacific Northwest Labs., Richland, WA). Nucl. Technol.; 18: No. 2, 78-79(May 1973).

Basic technology of plutonium utilization in the areas of plutonium recycle, neutronics of plutonium recycle, plutonium fuel technology, mixed-oxide fuel irradiation performance, and decontamination of reactor systems is briefly discussed. (FS)

7526 VALUE OF PLUTONIUM RECYCLE IN THERMAL REACTORS. Deonigi, D. E. (Battelle-Northwest, Richland, WA). Nucl. Technol.; 18: No. 2, 80-86(May 1973).

A generalized plutonium value equation is given which permits corrections for changes in separative work and uranium price: Pu value = AU – 0.16P (incremental fabrication cost per kg fuel/g of fissile Pu/kg fuel). In this equation, A is the relative worth of ^{239}Pu to ^{235}U as fissile material, U is the cost of 93% enriched uranium, and P is the ratio of ^{242}Pu content to fissile content. The optimum uranium enrichment to be used in plutonium-containing fuel rods is found to be equivalent to that of natural uranium. Incremental plutonium fabrication costs could go from ~100% over the projected uranium fabrication cost of $44/kg in 1975 to a 35% increase over this figure in 1985. In considering the throwaway cycle, it is found that the reprocessing will cost $56/kg compared with $21/kg for the throwaway. This leaves the cost difference of $35 as the minimum value of plutonium and uranium in discharged fuel. The value of plutonium in 1975 is estimated to be $7.50/g fissile, increasing to $8.50/g fissile by 1985. (auth)

7527 NEUTRONICS OF PLUTONIUM RECYCLING. Uotinen, V. O.; Leonard, B. R. Jr.; Liikala, R. C. (Battelle Northwest, Richland, WA). Nucl. Technol.; 18: No. 2, 115-140(May 1973).

The available experimental reactor physics data related to problems of plutonium recycle have been reviewed and analyzed. Included were data from both basic lattice studies and irradiation experiments. It is concluded that there exists a reasonable amount of experimental data on clean lattice critical arrays. Extension of the data base to include more information on fine structure parameters would improve the usefulness of the experimental data base for testing design methods. The principal area where neutronic data are lacking is in the irradiation behavior of plutonium-fueled cores. The precision of the basic cross section data for plutonium isotopes is reviewed. The precision to which the cross sections for the plutonium isotopes is known is nearly comparable to that for the uranium isotopes. On the basis of theory-experiment comparisons that have been published by several groups, the accuracy of existing calculational models needs to be improved. The principal area for improvement appears to be in calculating the thermal-neutron spectrum in plutonium-fueled systems. (auth)

Reactor Licensing and Regulation

7528 (DOCKET-50010-155) DRESDEN NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Quad-Cities Station, Units 1 and 2. Valve Wall Thickness. (Commonwealth Edison Co., Chicago, Ill). 15 Feb 1973. 3p. (DOCKET-50237-325; DOCKET-50249-218; DOCKET-50254-193; DOCKET-50265-182). Dep. NTIS $3.00.

7529 (DOCKET-50010-156) DRESDEN NUCLEAR POWER STATION, UNIT 1. Proposed Change to Appendix A to Permit Operation of Cycle 9, Supplement A. (Commonwealth Edison Co., Chicago, Ill.). 4 May 1973. 2p. Dep. NTIS $3.00.

7530 (DOCKET-50010-157) DRESDEN NUCLEAR POWER STATION, UNIT 1. Clarification of Letter Dated October 27, 1972 Concerning Control Valve Failure. (Commonwealth Edison Co., Chicago, Ill.). 9 May 1973. 2p. Dep. NTIS $3.00.

7531 (DOCKET-50029-247) YANKEE NUCLEAR POWER STATION. Control Rod Surveillance Testing Data Obtained on May 4, 1973. (Yankee Atomic Electric Co., Westboro, Mass.). 7 May 1973. 2p. Dep. NTIS $3.00.

7532 (DOCKET-50029-248) YANKEE NUCLEAR POWER STATION. Failure in Automatic Control due to Leakage in Pressure Sensing Line. (Yankee Atomic Electric Co., Rowe, Mass.). 14 May 1973. 2p. Dep. NTIS $3.00.

7533 (DOCKET-50029-249) YANKEE NUCLEAR POWER STATION. Operating Reactor at Power without Required Protective Trips. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 15 May 1973. 3p. Dep. NTIS $3.00.

7534 (DOCKET-50155-155) BIG ROCK POINT NUCLEAR PLANT. Palisades Plant. Circuit Breakers in Safety Related Equipment. (Consumers Power Co., Jackson, Mich.). 6 Apr 1973. 1p. (DOCKET-50255-155). Dep. NTIS $3.00.

7535 (DOCKET-50206-200) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Draft Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). May 1973. 235p. Dep. NTIS $13.75.

The environmental effects of construction and operation of the San Onofre Power Reactor Unit 1 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (DCC)

7536 (DOCKET-50219-259) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Requests for Authorization to Conduct Low Power Physics Tests. (Jersey Central Power and Light Co., Morristown, N. J.). 15 May 1973. 1p. Dep. NTIS $3.00.

7537 (DOCKET-50237-326) DRESDEN NUCLEAR POWER STATION, UNIT 2. Inspection Report 050-237/73-02. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 27 Apr 1973. 9p. Dep. NTIS $3.00.

7538 (DOCKET-50247-108) INDIAN POINT NUCLEAR GENERATING UNIT 2. Inspection Report No. 50-247/73-08. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 17 Apr 1973. 7p. Dep. NTIS $3.00.

7539 (DOCKET-50249-221) DRESDEN NUCLEAR POWER STATION, UNIT 3. Proposed Modification 73-2, Supplement A. (Commonwealth Edison Co., Chicago, Ill.). 1 May 1973. 3p. Dep. NTIS $3.00.

7540 (DOCKET-50249-223) DRESDEN NUCLEAR POWER STATION, UNIT 3. Motor Operated Valve 3-1501-22B Stopped in Mid Position. (Commonwealth Edison Co., Chicago, Ill.). 4 May 1973. 2p. Dep. NTIS $3.00.

7541 (DOCKET-50250-128) TURKEY POINT PLANT, UNIT 3. Reactor Coolant Loop Bypass Flow Transmitter Leak. (Directorate of Regulatory Operations (AEC), Atlanta GA (USA). Region II). 20 Apr 1973. 5p. Dep. NTIS $3.00.

7542 (DOCKET-50254-195) QUAD-CITIES STATION, UNITS 1 AND 2. Semiannual Nonradiological Environmental Report, Revised, August 1972–January 1973. (Industrial Bio-Test Labs., Inc., Northbrook, Ill.). 20 Apr 1973. 921p. (DOCKET-50265-184). Dep. NTIS $48.25.

For Commonwealth Edison Co., Chicago, IL.

7543 (DOCKET-50255-156) PALISADES PLANT. Inspection Report No. 050-255/73-01, February 2, 5, 6, 7, and 28, 1973. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 18 Apr 1973. 20p. Dep. NTIS $3.00.

7544 (DOCKET-50261-173) H. B. ROBINSON UNIT 2. Inquiry Report No. 50-261/73-2Q, Unplanned Liquid Release of Radioactive Material from the Site. (Carolina Power and Light Co., Raleigh, N. C.). 7 May 1973. 6p. Dep. NTIS $3.00.

7545 (DOCKET-50261-175) H. B. ROBINSON UNIT 2. Refueling Water Storage Tank Spill to the Plant Drainage System.

(Carolina Power and Light Co., Raleigh, N. C.). 11 May 1973. 2p. Dep. NTIS $3.00.

7546 (DOCKET-50261-176) H. B. ROBINSON UNIT 2. Hydrostatic Testing of Steam Generators. (Carolina Power and Light Co., Raleigh, N. C.). 11 May 1973. 6p. Dep. NTIS $3.00.

7547 (DOCKET-50265-189) QUAD-CITIES STATION, UNIT 2. Diesel Generator Auto Started. (Commonwealth Edison Co., Cordova, Ill.). 7 May 1973. 2p. Dep. NTIS $3.00.

7548 (DOCKET-50266-107) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. High Steam Flow Trip Setpoint Miscalibration. (Wisconsin Electric Power Co., Milwaukee). 5 May 1973. 2p. (DOCKET-50301-95). Dep. NTIS $3.00.

7549 (DOCKET-50266-108) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Technical Specifications, Request for Change 7. (Wisconsin Electric Power Co., Milwaukee). 5 May 1973. 24p. (DOCKET-50301-96). Dep. NTIS $3.25.

Information on technical specifications changes concerning heatup and cooldown, the chemical and volume control system, the plant operating organization, and protective instrumentation at the Point Beach Nuclear Plant, Units 1 and 2, is presented. (JWR)

7550 (DOCKET-50269-108) OCONEE NUCLEAR STATION, UNIT 1. Failure of Core Flood Line Isolation Valve CF-1 to Open Fully; Failure of Reactor Building Spray Valves to Open During ES System Testing. (Duke Power Co., Charlotte, N. C.). 4 May 1973. 3p. Dep. NTIS $3.00.

7551 (DOCKET-50269-109) OCONEE NUCLEAR STATION, UNIT 1. Reactor Coolant Pump Oil Fire on March 6, 1973. (Duke Power Co., Charlotte, N. C.). 4 May 1973. 15p. Dep. NTIS $3.00.

7552 (DOCKET-50269-111) OCONEE NUCLEAR STATION, UNIT 1. Request for Removal of Power Restriction. (Duke Power Co., Charlotte, N. C.). 14 May 1973. 4p. Dep. NTIS $3.00.

7553 (DOCKET-50270-91) OCONEE NUCLEAR STATION, UNITS 2 AND 3. Active Valve Operability. (Duke Power Co., Charlotte, N. C.). 1 May 1973. 10p. (DOCKET-50287-82). Dep. NTIS $3.00.

7554 (DOCKET-50275-39) DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2. Approval of Revisions to "Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California." (Environmental Protection Agency, San Francisco, Calif. (USA)). 10 Aug 1972. 1p. (DOCKET-50323-36). Dep. NTIS $3.00.

7555 (DOCKET-50277-91) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Inspection Report No. 50-277/73-06. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 27 Apr 1973. 15p. Dep. NTIS $3.00.

7556 (DOCKET-50277-92). PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Inspection Report No. 50-277/73-10. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 23 Apr 1973. 11p. Dep. NTIS $3.00.

7557 (DOCKET-50280-124) SURRY POWER STATION, UNITS 1 AND 2. State Water Control Board Certificate of Compliance with Applicable State Water Quality Standards. (Virginia State Water Control Board, Richmond (USA)). 11 Apr 1973. 2p. (DOCKET-50281-99). Dep. NTIS $3.00.

7558 (DOCKET-50280-131) SURRY POWER STATION, UNIT 1. USRE-S1-73-02, Reactor Coolant Flow Coastdown Measurement. (Virginia Electric and Power Co., Richmond). 25 Apr 1973. 7p. Dep. NTIS $3.00.

7559 (DOCKET-50280-132) SURRY POWER STATION, UNIT 1. Start-up Test Report. (Virginia Electric and Power Co., Richmond). 1 May 1973. 217p. Dep. NTIS $13.00.

7560 (DOCKET-50280-133) SURRY POWER STATION, UNIT 1. Inquiry Report No. 50-280/73-5Q, Emergency Diesel Generator Failure to Start. (Directorate of Regulatory Operations (AEC), Atlanta, GA (USA). Region II). 18 Apr 1973. 4p. Dep. NTIS $3.00.

7561 (DOCKET-50282-103) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. U. S. Department of Transportation, Comment on Draft Environmental Statement. (Federal Highway Administration, Homewood, Ill. (USA)). 11 Apr 1973. 1p. (DOCKET-50306-97). Dep. NTIS $3.00.

7562 (DOCKET-50282-115) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Faulty Overcurrent Trip Delay Devices in Circuit Breakers for Engineered Safety Systems. (Northern States Power Co., Minneapolis, Minn.). 17 Apr 1973. 1p. (DOCKET-50306-108). Dep. NTIS $3.00.

7563 (DOCKET-50282-116) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Inspection Reports Nos. 050-282/73-05 and 050-306/73-02. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 20 Apr 1973. 7p. (DOCKET-50306-109). Dep. NTIS $3.00.

7564 (DOCKET-50285-94) FORT CALHOUN STATION, UNIT 1. Pre-Operational Environmental Radioactivity Surveillance Program, Fourth Quarter, 1972. (Eberline Instrument Corp., Sante Fe, N. Mex. Dept. of Nuclear Sciences). 24 Apr 1973. 29p. Dep. NTIS $3.50.

For Omaha Public Power District, NE.

7565 (DOCKET-50286-81) INDIAN POINT NUCLEAR GENERATING UNIT 3. Final Facility Description and Safety Analysis Report, Supplement 18. (Consolidated Edison Co. of New York, Inc., New York). 8 May 1973. 47p. Dep. NTIS $4.50.

Revised and requested information for the final facility description and safety analysis report on the Indian Point Nuclear Generating Unit 3 is presented. (JWR)

7566 (DOCKET-50289-97) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Inspection Report No. 50-289/73-03. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 18 Apr 1973. 21p. Dep. NTIS $3.25.

7567 (DOCKET-50289-98) THREE MILE ISLAND NUCLEAR STATION, UNITS 1 AND 2. Environmental Report, Amendment 2. (Metropolitan Edison Co., Reading, PA). 2 May 1973. 21p. (DOCKET-50320-46). Dep. NTIS $3.25.

Revised information is presented concerning power transmission lines. (DCC)

7568 (DOCKET-50289-99) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Final Safety Analysis Report, Amendment No. 40. (Metropolitan Edison Co., Reading, PA). 11 May 1973. 32p. Dep. NTIS $3.75.

Environmental technical specifications are presented. (DCC)

7569 (DOCKET-50293-138) PILGRIM NUCLEAR POWER STATION. AO-73-15, Switches Isolated with Reactor Water Temperature Above 212°F, 5/5/73. AO-73-16, Differential Pressure Indicating Switch Failed to Close, 5/7/73. (Boston Edison Co., Mass.). 8 May 1973. 3p. Dep. NTIS $3.00.

7570 (DOCKET-50293-139) PILGRIM NUCLEAR POWER STATION. UO-73-6, Containment Spray Valves Inoperable. (Boston Edison Co., Mass.). 10 May 1973. 2p. Dep. NTIS $3.00.

7571 (DOCKET-50295-112) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Inspection Report No. 050-295/73-18. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 24 Apr 1973. 9p. Dep. NTIS $3.00.

7572 (DOCKET-50295-113) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Inspection Report No. 050-295/73-15. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 24 Apr 1973. 6p. Dep. NTIS $3.00.

7573 (DOCKET-50295-115) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Special Report No. 1, Main Steam Line Check Valve Modifications. (Commonwealth Edison Co., Chicago, Ill.). 7 May 1973. 87p. (DOCKET-50304-95). Dep. NTIS $6.50.

7574 (DOCKET-50295-116) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Authorization to Proceed with Testing Not to Exceed 163 Megawatts Thermal. (Directorate of Licensing (AEC), Washington, D. C.). 15 May 1973. 2p. Dep. NTIS $3.00.

7575 (DOCKET-50298-75) COOPER NUCLEAR STATION. State Certification That There Is Not an Applicable Effluent Limitation. (Nebraska Dept. of Environmental Control, Lincoln (USA)). 19 Apr 1973. 2p. Dep. NTIS $3.00.

7576 (DOCKET-50302-71) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. Steps Taken to Correct Items of Noncompliance Brought to Attention Following Inspection on January 23-25, 1973. (Florida Power Corp., St. Petersburg). 23 Mar 1973. 20p. Dep. NTIS $3.00.

Information is presented concerning the welding and nondestructive testing procedures for the decay heat and makeup and purification systems. (DCC)

7577 (DOCKET-50302-72) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. Inspection Report No. 50-302/73-2. (Directorate of Regulatory Operations (AEC), Atlanta, GA (USA). Region II). 17 Apr 1973. 14p. Dep. NTIS $3.00.

7578 (DOCKET-50305-80) KEWAUNEE NUCLEAR POWER PLANT. Inspection Report No. 050-305/73-03. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 30 Apr 1973. 17p. Dep. NTIS $3.00.

7579 (DOCKET-50305-81) KEWAUNEE NUCLEAR POWER PLANT. Safety Evaluation, Supplement 2. (Directorate of Licensing (AEC), Washington, D. C.). 10 May 1973. 62p. Dep. NTIS $5.25.

7580 (DOCKET-50313-75) ARKANSAS NUCLEAR ONE, UNIT 1. Final Safety Analysis Report, Amendment 37. (Arkansas Power and Light Co., Little Rock). 27 Apr 1973. 191p. Dep. NTIS $11.75.

Revised and requested information is presented concerning the cooling system, engineered safeguards, instrumentation, radioactive waste disposal, mechanical structures, auxiliary systems, accident analysis, and financial data on owners. (DCC)

7581 (DOCKET-50313-76) ARKANSAS NUCLEAR ONE, UNIT 1. Inspection Report No. 50-313/73-4. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 17 Apr 1973. 23p. Dep. NTIS $3.25.

7582 (DOCKET-50313-77) ARKANSAS NUCLEAR ONE, UNIT 1. Limitorque Valve Operator Failures. (Directorate of Regulatory Operations (AEC), Atlanta, GA (USA). Region II). 4 Dec 1972. 8p. Dep. NTIS $3.00.

7583 (DOCKET-50320-47) THREE MILE ISLAND NUCLEAR STATION, UNIT 2. Inspection Report No. 50-320/73-01. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 19 Apr 1973. 7p. Dep. NTIS $3.00.

7584 (DOCKET-50321-79) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Limitorque Valve Operator Failures. (Directorate of Regulatory Operations (AEC), Atlanta, GA (USA). Region II). 4 Dec 1972. 8p. Dep. NTIS $3.00.

7585 (DOCKET-50322-35) SHOREHAM NUCLEAR POWER STATION, UNIT 1. Inspection Report No. 50-322/73-02. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 17 Apr 1973. 11p. Dep. NTIS $3.00.

7586 (DOCKET-50323-39) DIABLO CANYON NUCLEAR POWER PLANT, UNIT 2. Vendor Inspection Report No. 99900036/73-05. (Directorate of Regulatory Operations (AEC), Berkeley, Calif. (USA). Region V). 19 Apr 1973. 10p. Dep. NTIS $3.00.

7587 (DOCKET-50324-79) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Inspection Reports Nos. 50 325/73-2 AND 50-324/73-2. (Directorate of Regulatory Operations (AEC), Atlanta, GA. (USA). Region II). 17 Apr 1973. 21p. (DOCKET-50325-80). Dep. NTIS $3.25.

7588 (DOCKET-50331-96) DUANE ARNOLD ENERGY CENTER. Westinghouse Circuit Breakers. (Iowa Electric Light and Power Co., Cedar Rapids). 14 Mar 1973. 1p. Dep. NTIS $3.00.

7589 (DOCKET-50333-92) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Intake Structure Bar Heating. (Power Authority of the State of New York). 4 May 1973. 2p. Dep. NTIS $3.00.

7590 (DOCKET-50334-64) BEAVER VALLEY POWER STATION, UNIT 1. Draft Environmental Statement, Applicant's Comments. (Duquesne Light Co., Pittsburgh, PA). 1 May 1973. 12p. Dep. NTIS $3.00.

7591 (DOCKET-50334-66) BEAVER VALLEY POWER STATION, UNIT 1. Final Safety Analysis Report, Amendment 2. (Duquesne Light Co., Pittsburgh, PA). 7 May 1973. 464p. Dep. NTIS $25.25.

Revised and requested data are presented concerning auxiliary systems, electrical systems, reactor site, instrumentation, power conversion system, control system, and containment structure. (DCC)

7592 (DOCKET-50341-58) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Control Rod Guide Tube Collapse. (Detroit Edison Co., MI). 9 May 1973. 22p. Dep. NTIS $3.25.

7593 (DOCKET-50367-40) BAILLY GENERATING STATION, NUCLEAR 1. Load and Capacity Report. (Northern Indiana Public Service Co., Hammond). 8 May 1973. 2p. Dep. NTIS $3.00.

7594 (DOCKET-50369-40) McGUIRE NUCLEAR STATION, UNITS 1 AND 2. Inspection Reports Nos. 50-369/73-1 and 50-370/73-1. (Directorate of Regulatory Operations (AEC), Atlanta, GA. (USA). Region II). 27 Apr 1973. 24p. (DOCKET-50370-39). Dep. NTIS $3.25.

7595 (DOCKET-50387-38) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Control of Gaseous Iodine Releases. (Pennsylvania Power and Light Co., Allentown). 11 May 1973. 1p. (DOCKET-50388-37). Dep. NTIS $3.00.

7596 (DOCKET-50400-42) SHEARON HARRIS NUCLEAR POWER PLANT, UNITS 1, 2, 3, AND 4. Safety Evaluation With Supplement No. 1. (Directorate of Licensing (AEC), Washington, D. C.). 27 Apr 1973. 229p. (DOCKET-50401-42; DOCKET-50402-42; DOCKET-50403-42). Dep. NTIS $13.00.

7597 (DOCKET-50400-43) SHEARON HARRIS NUCLEAR POWER PLANT, UNITS 1, 2, 3, AND 4. Final Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). May 1973. 330p. (DOCKET-50401-43; DOCKET-50402-43; DOCKET-50403-43). Dep. NTIS $18.50.

The environmental effects of construction and operation of the Shearon Harris Power Reactor Units 1, 2, 3, and 4 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (DCC)

7598 (DOCKET-50404-50) NORTH ANNA POWER STATION, UNITS 3 AND 4. Preliminary Safety Analysis Report, Amendment 16. (Virginia Electric and Power Co., Richmond). 4 May 1973. 154p. (DOCKET-50405-49). Dep. NTIS $9.75.

A compilation of the correspondence between the applicant and the Atomic Energy Commission relevant to the construction of North Anna Power Station, Units 3 and 4, is presented. Topics discussed include the service water system, radiation monitoring, waste treatment, containment, accident analysis, auxiliary systems, power conversion system, and others. (JWR)

7599 (DOCKET-50404-51) NORTH ANNA POWER STATION, UNITS 3 AND 4. Planned Radiological Environmental Surveillance Plan. (Virginia Electric and Power Co., Richmond). 4 May 1973. 6p. (DOCKET-50405-50). Dep. NTIS $3.00.

7600 (DOCKET-50409-46) LA CROSSE BOILING WATER REACTOR. Technical Specifications, Change 10. (Directorate of Licensing (AEC), Washington, D. C.). 26 Mar 1973. 2p. Dep. NTIS $3.00.

Revised technical specifications are presented concerning the required test schedule for the forced circulation system controls and automatically operated valves. (DCC)

7601 (DOCKET-50409-47) LA CROSSE BOILING WATER REACTOR. Westinghouse Circuit Breakers. (Dairyland Power Cooperative, La Crosse, WI). 29 Mar 1973. 1p. Dep. NTIS $3.00.

7602 (DOCKET-50409-48) LA CROSSE BOILING WATER REACTOR. Abnormal Reactor Vessel Heatup Rate. (Dairyland Power Cooperative, La Crosse, WI). 21 Mar 1973. 18p. Dep. NTIS $3.00.

7603 (DOCKET-50409-49) LA CROSSE BOILING WATER REACTOR. High Pressure Emergency Core Spray System. (ECCS) Pipe Fitting Leakage. (Dairyland Power Cooperative, La Crosse, WI). 1 May 1973. 4p. Dep. NTIS $3.00.

7604 (DOCKET-50409-50) LA CROSSE BOILING WATER REACTOR. Refueling Plan. (Dairyland Power Cooperative, La Crosse, WI). 4 May 1973. 13p. (DPC-851-56). Dep. NTIS $3.00.

7605 (DOCKET-50409-51) LA CROSSE BOILING WATER REACTOR. Monthly Operating Report for February 1973. (Dairyland Power Cooperative, La Crosse, WI). 1973. Contract AT(11-1)-851. 28p. (DPC-851-55). Dep. NTIS $3.50.

7606 (DOCKET-50413-19) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of

Advisory Council on Historic Preservation. (Advisory Council on Historic Preservation, Washington, D. C. (USA)). 4 May 1973. 1p. (DOCKET-50414-19). Dep. NTIS. $3.00.

7607 (DOCKET-50413-20) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 8. (Duke Power Co., Charlotte, N. C.). 15 May 1973. 366p. (DOCKET-50414-20). Dep. NTIS $20.50.

Additional information on the ice condenser system and the TMD code used for its analysis at the Catawba Nuclear Station, Units 1 and 2, is presented. (JWR)

7608 (DOCKET-50416-24) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. AEC Press Release Concerning Standardization. (Mississippi Power and Light Co., Jackson (USA)). 10 May 1973. 2p. (DOCKET-50417-24). Dep. NTIS $3.00.

7609 (RAI-73-4) REGULATORY ADJUDICATION ISSUANCES, APRIL 1973. (Technical Information Center (AEC), Oak Ridge, Tenn.). 15 May 1973. 82p. TIC.

Issuances received from the U. S. Atomic Energy Commission, the Atomic Safety and Licensing Appeal Boards, and the Atomic Safety and Licensing Boards are presented. (JWR)

7610 STANDARDS FOR THE NUCLEAR INDUSTRY. Rogers, L. (Atomic Energy Commission, Washington, DC). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 698-701(Feb 1973).

The development and requirements of standards for the licensing of U. S. power reactors are reviewed. (DCC)

7611 CLASSIFICATION SCHEMES FOR EQUIPMENT USED IN NUCLEAR POWER GENERATING STATIONS. Gilbert, W. D. (General Electric Co., San Jose, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 702-709(Feb 1973).

The variety of classification schemes which are encountered in the regulatory process and in the standards writing groups for nuclear power generating stations is reviewed. The efforts of the American Nuclear Society BWR Criteria Subcommittee pertaining to equipment classification and design requirements for boiling water reactors are discussed. (auth)

7612 QUALITY ASSURANCE SYSTEMS REQUIREMENTS FOR NUCLEAR POWER PLANTS. Marsh, S. A. (STAT-A-MATRIX, Edison, NJ). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 710-714(Feb 1973).

There are currently at least five documents in use for quality system requirements. These are: Mil-Q-9858 A; AEC-10 CFR 50, Appendix B; ASME-Section III, Article NA 4000; ANSI-N-45.2; and AEC-RDTF2-2T. These documents have many things in common and also some differences. The roles of these documents are reviewed. Similarities and differences are described. The question of developing a single quality system that will economically satisfy any one or all five of these documents is dealt with and a plan for effectively accomplishing this, whether the company has five or five thousand employees, is explained. (auth)

7613 REPORT ON INTERNATIONAL STANDARDS. Moore, V. A. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 1, 715-716(Feb 1973).

Information is presented concerning the international standards relating to reactor instrumentation and control systems. (DCC)

GENERAL

Energy Utilization and Economics

7614 (CONF-730432-1) OPPORTUNITY COSTS OF LANDSCAPE MODIFICATION BY COAL SURFACE MINING. Spore, R. L. (Oak Ridge National Lab., Tenn.). 1972. 16p. Dep. NTIS $3.00.

From 3rd Mid-Atlantic Regional Science Meeting; Syracuse, New York, USA (28 Apr 1973).

A framework is developed for determining preferred land use in the case when alternative land uses are incompatible and one of the uses involves the preservation of the natural environment in order to ensure a flow of goods and services of the public goods type. Another framework applies for an area possessing not only strippable reserves of coal but natural features of value for outdoor recreation. An economic evaluation is made of the basin of the Big South Fork of the Cumberland River in Tennessee, USA. (JCW)

7615 (SLA-73-357) SOLAR COMMUNITY AND THE CASCADED ENERGY CONCEPT APPLIED TO A SINGLE HOUSE AND A SMALL SUBDIVISION. A Status Report. Pope, R. B.; Schimmel, W. P. Jr. (Sandia Labs., Albuquerque, N. Mex.). May 1973. 35p. Dep. NTIS $3.00.

An analytical study of the application of the Sandia Laboratories solar community concept to a single house and to a 20-house subdivision is described. The specific system analyzed utilities focused collectors, high-temperature water storage, and cascaded energy. Daily and annual projected performances of different collector fields and the annual projected fuel savings and relative costs of the system are presented for a community located in Albuquerque, New Mexico. Requirements for the peak heating and air conditioning demands are shown. (auth)

7616 (TID-26277) 1972 ATOMIC ENERGY PROGRAMS: OPERATING AND DEVELOPMENTAL FUNCTIONS. (Atomic Energy Commission, Washington, D. C.). 1973. 110p. Dep. GPO $1.75.

Separate abstracts were prepared on the five chapters. (CH)

For abstracts of individual chapters see: 5503, 5850, 7617, 7622, and 7623.

7617 (TID-26277, pp 1-27) EXPANDED ENERGY MISSION. 1973.

1972 atomic energy programs: operating and developmental functions.

Research and development are continued by the AEC to provide aid to clean energy generation. The basic problem is to find ways and means for striking a proper balance between meeting the nation's future vital needs and protecting and enhancing the environment and the health and safety of the public. At the end of 1972, there were 29 nuclear units in operation, 55 under construction, and 76 contractually ordered for a combined capacity of 142,457 MW(e). Superconductor power transmission, energy-storage batteries, geothermal resources, and synthetic fuel development are discussed. Nuclear gas stimulation for today's needs and the breeder reactor and other reactor concepts for tomorrow's needs are delineated. Nuclear reactor safety, desalting studies, and the space nuclear systems are discussed and then, the supportive information needed, including training and education, patents, and information dispensation are summarized. (JCW)

Information Handling

7618 (JUL-CONF-7) INFORMATION CONFERENCE DATA PROCESSING IN RESEARCH, JULICH, GERMANY, 12–13 October 1972. Meuer, H. W. (ed.) (Kernforschungsanlage, Juelich (West Germany)). Oct 1972. 218p. (In German and English). (CONF-721083-). Dep. NTIS (U. S. Sales Only) $13.00.

Abstracts have been prepared for two of the thirteen papers which were presented at this Conference. (FS)

For abstracts of individual papers see: 7136 and 7442.

Law

7619 (BRH OBD-73-2) STATE RADIATION CONTROL LEGISLATION, 1971. Miller, L. A. (Food And Drug Administration, Rockville, MD. (USA)). Jul 1972. 60p. NTIS.

DHEW Publication (FDA) 73-8002.

This report, which presents a review of state radiation control legislation for calendar year 1971, is presented in state, subject, and status order. An index and a brief description of each bill introduced in 1971 are included, plus existing laws or statutes governing radiation control. (auth)

Management

7620 (EUR-4886) COMMUNITY SURVEY ON STANDARD REFERENCE MATERIALS. (European Communities, Luxembourg. Commission). Mar 1973. 106p. Dep. NTIS (U. S. Sales Only) $7.50. EUR B.Fr. 125.-.

This report analyses the results of a survey carried out in 1971 by the JRC on the use of and demand for standard reference materials (SRMs) by scientific, industrial and commercial laboratories in the countries of the Community. The first part of the report deals with the background to the survey, its mechanism and the laboratories consulted. The fields of activity of the laboratories, sources of supply, criteria for choice and criticism of the SRMs currently available on the market are discussed in succession. The demand is analyzed in accordance with product families, the analytical methods which the SRMs are used to calibrate and the desired ranges of concentration. The main product families into which standard reference materials of certified composition and/or purity fall are: metallurgical products, organic and inorganic chemicals, pharmaceuticals, food products and medical analysis. A separate section is devoted to standard reference materials having certified properties. The final section deals with the possible participation of laboratories in a concerted European-scale action. The extent to which the survey was successful is indicated. (auth)

7621 (TID-26162) "MAY THE ATOM . . ." A Report of the U. S. Atomic Energy Commission Delegation to the U.S.S.R., August 1971. Lewin, J. (comp.) (Technical Information Center (AEC), Oak Ridge, Tenn.). Oct 1972. 216p. Dep. NTIS $3.00.

Within the Soviet Union, the American delegation visited nine cities over a period of ten days. In the Moscow area, the delegation visited the Institute of High Energy Physics near Serpukhov, the Institute of Physics and Power Engineering at Obninsk, and the Kurchatov Institute of Atomic Energy in Moscow. The itinerary and speeches delivered by members of the delegations are outlined in the report. The tour included elements of many areas of nuclear science—from stable isotope separation to power reactor construction. A number of salient impressions regarding the Soviet Atomic Energy Program are discussed. (JCW)

7622 (TID-26277, pp 45-64) CONTINUING ENVIRONMENTAL CHALLENGE. 1973.

1972 atomic energy programs: operating and developmental functions.

The role of the AEC in environmental programs since its inception is reviewed. It is pointed out that for more than a quarter-century the protection of man and the environment from the effects of man-made radiation sources has been a basic AEC responsibility. A wide-ranging environmental research program has also been carried out at AEC sites to assess the effects of waste heat from reactors on river ecosystems, to develop methods for the control of the release of chemical pollutants to the environment, and to provide information on all aspects of nuclear energy operations as they affect the environment. The concepts of the National Environmental Policy Act of 1969 (NEPA) have broadened the responsibilities of the AEC to include the full range of environmental impact. Before the implementation of NEPA the legal role of the AEC was limited to radiation aspects insofar as its licensing actions were concerned. Under NEPA the direct responsibility for evaluating and assessing the total environmental impact of nuclear facilities is the responsibility of the AEC, and a constructive program has been implemented to meet energy requirements while maintaining environmental quality in response to new national goals. Research programs of the AEC and cooperative programs with other agencies to obtain these goals are reviewed briefly. (CH)

7623 (TID-26277, pp 65-89) NEED FOR BASIC RESEARCH. 1973.

1972 atomic energy programs: operating and developmental functions.

, The AEC conducts basic research in the life and physical sciences and the interrelationships are phenomenal. Controlled thermonuclear device studies for power production include: magnetic bottle systems, open and closed systems, the adiabatic toroidal compressor, the DC Octupole device, the FM-1 Spherator experiment, the Doublet-II experiment, the turbulent torus experiment, the Scyllac device, and superconducting magnetic storage and transfer devices. The production of fusion energy through laser irradiation of solid particles of heavy hydrogen isotopes is underway. Recent developments discussed include cancer therapy, solar conversion equipment, reduction of x-ray exposures, californium-252, hybrid plant development in culture, luminescence measurements, trace element analysis, and low-level radiation studies. (JCW)

7624 (UCC-ND-246) MINORITY PRE-CO-OP PROGRAM FOR HIGH SCHOOL GRADUATES. (Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.). May 1973. 37p. Dep. NTIS.

A program to encourage the entry of black students into science and engineering studies was undertaken in the summer of 1969 by the Nuclear Division of Union Carbide Corporation. Five black universities recruited about 26 high school graduates each year for the program, and Union Carbide provided summer employment prior to the students' five year of college as well as books and tuition during the freshman year. Students then entered cooperative education programs of alternate study and work after their freshman year in college. This report reviews the activities and results of the pre-co-op program through its first three years of full operation. (MCW)

Mathematics and Computers

7625 (AEEW-R-822) SYNCON: GENERAL SYNTAX CONVERSION AND COMPUTER PROGRAM. Bindon, D. C. (Atomic Energy Establishment, Winfrith (England)). Sep 1972. 52p. Dep. NTIS (U. S. Sales Only) $4.75.

The problems of syntax conversion are discussed, and the reasons given for the choice of the interpretive method. A full description is given of the SYNCON language and computer program together with brief details of some programs written in the language. (auth)

7626 (BNL-17677) COMPUTER-CONTROLLED DATA ACQUISITION SYSTEM FOR AUTOMATED AMINO-ACID ANALYSIS. Hohberger, C. P.; Soucek, B.; Chase, R. L.; Potter, D. (Brookhaven National Lab., Upton, N. Y.). Feb 1973. Contract AT(30-1)-16. 56p. Dep. NTIS $5.00.

A computer-oriented continuous signal sampling and recording system is described for amino acid analysis in ion-exchange chromatography. The system employs synchronous tape drives for multiplexed data storage from four amino acid analyzer colorimeter outputs. Each amino acid analyzer provides three colorimeter outputs. All twelve continuous signals are digitized through voltage-to-frequency to count conversion. The PDP-8/L computer controls the data acquisition system, buffers data to magnetic tape and also provides for concurrent transfer of tape data via the BROOKNET II data link to a CDC6600 computer for data reduction. (auth)

7627 (BNL-17747) BNL HARDWARE MONITOR. Peskin, A. M. (Brookhaven National Lab., Upton, N. Y.). 1972. 19p. (CONF-730522-2). Dep. NTIS $3.00.

From AEC scientific computer information exchange meeting; San Francisco, California, USA (3 May 1973).

A hardware monitoring device was built as a tool to complement software-only techniques for performance measurement. A block diagram of the hardware monitor is given. It consists of twenty-four input channels, a diode matrix, eight eighteen-bit scalers, a multiplexer, an indicator panel and a tape writing system, as well as several uncommitted logic circuits including an internal oscillator. (MOW)

7628 (CONF-730419-2) ENGINEERING TEST AND CONTROL COMPUTERS. Adams, R. K.; Herskovitz, M. B. (Oak Ridge National Lab., Tenn.). 1973. 5p. Dep. NTIS $3.00.

From eighth annual conference on the use of digital computers in process control; Knoxville, Tennessee, USA (16 Apr 1973).

Two minicomputer systems are described for testing the performance and fabrication specifications for nuclear reactor temperature sensors. (MOW)

7629 (CONF-730522-3) COMPUTER SYSTEM PERFORMANCE MONITORING AT ORNL. Sullivan, J. G. (Oak Ridge National Lab., Tenn.). [nd]. 4p. Dep. NTIS $3.00.

From AEC scientific computer information exchange meeting; San Francisco, California, USA (3 May 1973).

The ORNL Computing Center consists of an IBM 360/91, an IBM 360/75, and a DEC PDP-10. The DEC PDP-10 is tied to the two IBM computers through 40.8KB telephone lines. The two IBM computers share 28 disk packs and one data cell drive. The IBM 360/91 contains 2,048K bytes of memory; the 360/75 contains 512K of fast memory ($^3/_4$ μsec) and 2048K of slow memory (8 μsec). Monitoring activities on the IBM computers only are considered. System monitoring on the 360/91 is generally applicable to the 360/75 system; however, the disparity in memory speed on the 360/75 is a complicating factor. (auth)

7630 (CONF-730610-1) COMMENTS ON THE GAMMA DISTRIBUTION AND USES IN RAINFALL DATA. Shenton, L. R.; Bowman, K. O. (Oak Ridge National Lab., Tenn.). 1973. 8p. Dep. NTIS $3.00.

From 3rd conference on probability and statistics in atmospheric science; Boulder, Colorado, USA (19 Jun 1973).

7631 (CTC-INF-1046) ENHANCING SOFTWARE RELIABILITY THROUGH DOCUMENTATION. Price, C. E. (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). 1973. Contract W-7405-eng-26. 16p. (CONF-730424-1). Dep. NTIS $3.00.

From software reliability symposium; New York, New York, USA (30 Apr 1973).

Software reliability can be greatly enhanced by properly done documentation. In fact, a computer program by itself is a sterile thing, without utility, unless there is documentation to identify what it does and how to use it. Thus, documentation must exist in order for software to function at any level of reliability and good documentation can help make programs more reliable. Reliability, in this paper, is intended to encompass all those factors that contribute to a user obtaining expected, trustworthy results from software. (MOW)

7632 (EUR-4959) ALGORITHM FOR NONLINEAR DATA FIT BY THE LEAST SQUARES METHOD. van der Voort, E.; Halleux, J. P. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Apr 1973. 64p. Dep. NTIS (U. S. Sales Only) $5.25. EUR B. Fr. 85.-.

The least squares estimation of the parameters of a nonlinear curve is accomplished by using the Taylor's series of the summed squares of the residues (Φ) and retaining all the components up to the second order term. The advantage of this method over other methods lies in the fact that the Hessian matrix of the function, Φ, is calculated without any approximation. This procedure allows the rapid localization of the optimal parameters using known second order methods. Moreover, a brief statistical analysis is given that is based on the exact evaluation of the above mentioned Hessian matrix evaluated at the optimal point in the parameter space. Finally, a complete listing of a computer program together with a workout example and its output is included. (auth)

7633 (GEPP-102) INTERFACE FOR HAZELTINE 2000 CRT TERMINAL AND INTERDATA MINICOMPUTERS. Howell, J. F. (General Electric Co., St. Petersburg, FL. Neutron Devices Dept.). 25 May 1973. Contract AT(29-2)-656. 5p. Dep. NTIS $3.00.

An interface board provides interconnection between the Hazeltine Model 2000 CRT Terminal and Interdata Minicomputers. The interface supports all the Hazeltine terminal capabilities and such attachments as cassette unit, printer, etc. It supports the terminal in either the batch or half-duplex modes and at all baud rates from 110 through 9600. The Hazeltine terminal was utilized very successfully with the interface in the generation and editing of source programs, program assembly, and the loading and storage of programs and data. (auth)

7634 (HMI-B-130) RESULTS OF A FORTRAN BENCHMARK CONDUCTED ON FIVE LARGE-SCALE COMPUTER SYSTEMS RUNNING IN BATCH MODE. Beier, K. P. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). Jan 1973. 37p. (In German). Dep. NTIS (U.S. Sales Only) $4.00.

Benchmark results were obtained from measurements which were conducted on the large scale computer systems CD 6500 (CD 6400), CD CYBER 72, TR 440, IBM 360/67 and PDP 10 running in batch mode. The benchmark is based on a job-mix consisting of 18 selected FORTRAN programs. The several programs and the carrying-out of the measurements are described and the validity of this benchmark is discussed. (auth)

7635 (KAPL-P-3962) ALGEBRAIC-GEOMETRY FOUNDATIONS FOR FINITE-ELEMENT COMPUTATION. Wachspress, E. L. (Knolls Atomic Power Lab., Schenectady, N. Y.). 1973. Contract W-31-109-eng-52. 11p. Dep. NTIS $3.00.

7636 (LA-UR-73-150) GRAPHICS AND ENGINEERING. Baker, L. H. Jr.; Tucker, E. K. (Los Alamos Scientific Lab., NM). 1973. 9p. (CONF-730604-1). Dep. NTIS $3.00.

From national computer conference and exposition; New York, New York, USA (4 Jun 1973).

The greatest bottleneck in the widespread use of computers is the presentation of comprehensible output to the users. This is nowhere more apparent than in engineering studies including the computer simulation of complex, time-dependent phenomena. Motion pictures are the natural medium for presenting this type of data. The movies allow one to discover, validate, and pinpoint things that would have been practically impossible to detect in the numerical output. A new technique is now being used routinely as an output medium at the Los Alamos Scientific Laboratory. Using standard microfilm plotters and processing, color/sound motion pictures are generated in a single pass with a very high information density. (auth)

7637 (MLM–2058(TR)) SOME OF THE METHODS OF THE POISSON PROCESS GENERATION. Pleszczynska, E. 1963. Translated for Mound Lab., Miamisburg, Ohio, from report. 14p. Dep. NTIS $3.00.

The generator of random numbers with given distribution and the generator realizing the stochastic process are defined. The construction method is given for the generator of Poisson's homogeneous process by means of the generator of random numbers with a ratio distribution with parameter 1, called generator W. The construction methods for generator W are described. (auth)

7638 (RT/EDP–(73)1) RELEASE: A COMMAND PROCESSOR TO RELEASE UNUSED SPACE IN TSO DATA SETS. Corradi, C. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 16 Nov 1972. 31p. Dep. NTIS (U. S. Sales Only) $3.75.

The command processor RELEASE is described, which performs the release of unused disk space in TSO data sets. This facility is not provided by the standard IBM commands. (auth)

7639 (SC-DC-720674) STRATEGY FOR THE USE OF A MINICOMPUTER-BASED TEST SYSTEM AS A GENERAL-PURPOSE NDE LABORATORY TOOL. Stiefeld, B. (Sandia Labs., Albuquerque, N. Mex.). [nd]. 9p. (CONF-730606-2). Dep. NTIS $3.00.

The problems associated with hardware/software limit the use of computers in the NDE laboratory. A strategy is described which minimizes these problems and provides the occasional computer user with the tools to interface his experiment to a computer-based test system. The software component provides high-level, relatively simple language to enable the experimenter to do the bulk of the programming that may be required. The objective is to allow the NDE technologist, who may be a relative novice in the computer field, to effectively apply the power of computer-based test methods to his experiments. (auth)

7640 (SLA-73-349) COSMOS: CENTRIFUGE OPERATING SYSTEM PROGRAM. Darsey, D. M. (Sandia Labs., Albuquerque, N. Mex.). Apr 1973. 40p. Dep. NTIS $4.00.

An operating system program for the Redcor minicomputer allows creation of a software library on magnetic tape. Operator keyboard commands are used to selectively search and load called library programs, load nonlibrary programs, change I/O unit assignments, set program options, and configure the priority interrupt system. This document describes the operating instructions, library generation, and system configuration. (auth)

7641 (SLA–73–394) CHARACTERISTICS AND DEVELOPMENT REPORT ON THE SA2186 INTEGRATED CIRCUIT. Skogmo, D. G. (Sandia Labs., Albuquerque, NM). Apr 1973. 55p. Dep. NTIS $4.75.

The SA2186 is an integrated circuit four-channel latch. Its function is to acquire short-duration current–pulse information from magnetic cores and to hold this information for a time sufficient for it to be acquired by MOS logic. Electrical characterization data and geometrical information are presented. (auth)

7642 (SLA–73–5292) COMPUTER SYSTEMS PERFORMANCE MONITORING AT SANDIA LABORATORIES, ALBUQUERQUE. Davis, R. F. Jr. (Sandia Labs., Albuquerque, N. Mex.). [nd]. 8p. (CONF-730522-1). Dep. NTIS $3.00.

From AEC scientific computer information exchange meeting; San Francisco, California, USA (3 May 1973).

During 1972, Sandia Laboratories, Albuquerque utilized several techniques for the measurement and prediction of computer system performance. A popular commercial hardware monitor was leased for the purpose of (1) obtaining "hands-on" familiarity with the tool and (2) measuring identical gross-performance parameters on the Laboratories' major computer systems (two CDC-6600's, a UNIVAC 1108, and an IBM 360/50). From this exploratory investigation, it was found that hardware monitoring requires the expertise of qualified people from several different fields and is frequently more limited in capability or level of technical support than claimed by the vendors. (MOW)

7643 (SLL-73-232) USERS' MANUAL FOR PROGRAM LETTER. Affeldt, B. E. (Sandia Labs., Livermore, Calif.). Apr 1973. Contract AT(29-1)-789. 15p. Dep. NTIS $3.00.

The Program LETTER was written to facilitate the use of the lettering routines in the APT Program. By using a simple language the programmer has the ability to generate input cards for APT. (auth)

7644 (STAN-CS–73-335) COMPUTATION OF THE STATIONARY DISTRIBUTION OF AN INFINITE MARKOV MATRIX. Golub, G.; Seneta, E. (Stanford Univ., CA. Dept. of Computer Science). Jan 1973. 12p. (SU–326-P-30-24). Dep. NTIS $3.00.

An algorithm is presented for computing the unique stationary distribution of an infinite stochastic matrix possessing at least one column whose elements are bounded away from zero. Element-wise convergence rate is discussed by means of two examples. (auth)

7645 (SU–326-P-30-25) COMPUTATION OF THE LIMITED INFORMATION MAXIMUM LIKELIHOOD ESTIMATOR. Dent, W.; Golub, G. H. (Stanford Univ., Calif. Dept. of Computer Science). Feb 1973. 28p. (STAN-CS–73-339). Dep. NTIS $3.50.

Computation of the Limited Information Maximum Likelihood Estimator (LIMLE) of the set of coefficients in a single equation of a system of interdependent relations is sufficiently complicated to detract from other potentially interesting properties. Although, for finite samples, the LIMLE has no moments, asymptotically it remains normally distributed and retains other properties associated with maximum likelihood. A numerically stable estimation scheme based on Householder transformations and the singular value decomposition is presented. The analysis permits a convenient demonstration of equivalence with the Two-Stage Least Squares Estimator (TSLSE) in the instance of just identification. (MOW)

7646 (TP-483) UNCONSTRAINED MINIMIZATION ALGORITHMS WITHOUT COMPUTATION OF DERIVATIVES. Powell, M. J. D. (Atomic Energy Research Establishment, Harwell (England)). Apr 1972. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

Although direct search methods and algorithms that estimate derivatives are mentioned, this paper mainly concerns conjugate-direction algorithms of the type described by Powell (1964). These algorithms often work well in practice, but difficulty can occur due to linear dependence in the search directions that are used. Therefore, a new and promising technique is proposed for constructing suitable search directions. (auth)

7647 (UCID-16140(Rev. 1)) ASSEMBLER PROGRAM FOR THE INTEL MCS-8 8008 CPU. Magnuson, W. Jr. (California Univ., Livermore. Lawrence Radiation Lab.). 15 Feb 1973. 26p. Dep. NTIS $3.50.

This report is both a user's manual for the CDC-7600 computer program MCS8 as well as a reference manual for the INTEL 8008 symbolic assembly language. The MCS8 program accepts as input, programs written in INTEL 8008 CPU assembly language using mnemonic symbols for the instruction operations and creates two output files: A standard assembly output (symbol table, object, and source code) and a formatted object code output. The program will also write a magnetic tape (a program option) in formatted object code in 1601 format (PN tape) which can then be used to punch a paper tape utilizing the CDC 160A computer in building 113. The reference manual for the symbolic assembly language appears as appendix A which is essentially a duplication of Section II of the INTEL writeup titled "MC8 8008 Assembler." (auth)

7648 (UCRL-Trans-10686) ONE CLASS OF INVARIANT DIFFERENCE SCHEMES. Shokin, Yu. I.; Fedotova, Z. I. Translated from Chislennye Metody Mekh. Sploshnoi Sredy; 3: No. 5, 85-94(1972). 14p. Dep. NTIS $3.00.

A class of finite-difference schemes is investigated. The first differential approximation allows the same group of transformations as the approximated system of equations of gas dynamics in Lagrange coordinates with one spatial variable. The results of numerical calculation are given. (auth)

Miscellaneous

7649 (AECL-4080) GUIDE TO MAKING STATISTICAL TESTS WITH SMALL SAMPLES. Jarvis, R. G. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.).

Feb 1973. 45p. Dep. NTIS (U. S. Sales Only) $4.25. AECL $1.50.

This report deals with tests made on small samples taken from a batch of units. The uncertainty in the conclusions is assessed in several ways that are different from the usual tables and are intended to be suitable for deciding whether a particular sample size can be expected to yield significant results. After the sampling procedure has been decided, the resulting measurements can be analyzed by the standard methods. (auth)

7650 (AECL-4352) WEAR OF 304 SS VERSUS WAUKESHA-88 IN WATER: DESIGN EQUATIONS AND GRAECO-LATIN SQUARE ANALYSIS. Cecco, V. S.; Ko, P. L. (Atomic Energy of Canada LTD., Chalk River (Ontario). Chalk River Nuclear Labs). Feb 1973. 40p. Dep. NTIS (U. S. Sales Only) $4.00. CAN $1.00.

Wear results of 304 SS journals versus Waukesha-88 bearings in water are analyzed. The volume of wear of the journal and bearing and the three design parameters of distance, speed and load, were statistically correlated to obtain design equations with a safety factor. The other variables, coefficient of friction, wear scar angular location, surface roughness, hardness and the "wear-in" factor were individually analyzed and presented in graphical form. The data filled a 6 × 6 × 9 Graeco–Latin square with the design variables ranging from 2 to 100 ft/min, 2 to 100 lb and up to 5×10^6 in., respectively, for speed, load, and distance. The wear tests were performed in 80°F and pH 7 water. (J)

7651 (AECL-4432) PERFORMANCE ANALYSIS OF AXISYMMETRIC FLAT-FACE MECHANICAL SEALS. Metcalfe, R. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Feb 1973. 14p. Dep. NTIS (U. S. Sales Only) $3.00. AECL $0.50.

Hydrostatic lubrication resulting from axisymmetric mechanical and thermal distortion of initially flat mechanical seal components is investigated. It is believed that this effect is responsible for successful operation of many conventional seals. Interaction between mechanical and thermal distortions is discussed. It is shown that for an outside pressurized seal, full film hydrostatic lubrication is possible even if mechanical distortion under pressure is unfavorable, since favorable thermal distortion is then able to predominate. The effect of wear on this proposed "hydrostatic" mode of sealing is considered. Accurate analyses of fluid mechanics, heat transfer and elastic distortion aspects of the hydrostatic sealing mechanism are described. These in turn enable iteration (by computer) to a full solution. Capabilities of the developed computer program in analyzing any axisymmetric flat face seal design and predicting performance, providing boundary conditions can be specified, are demonstrated. It must be determined from each result whether the initial assumption of full fluid film lubrication is indeed justified. Performance correlation of reported experimental results with those computed for the same seal design is shown to be good, particularly when leakage and friction contributed by actual seal face imperfections are accounted for. It is concluded that the program will be of substantial benefit in predicting, explaining, and designing for performance. (auth)

7652 (AEC-tr-7426) METHODS AND TECHNIQUE OF THE MACHINE ANALYSIS OF BIOLOGICAL STRUCTURES. 1972. Translation of Metody i Tekhnika Mashinnogo Analiza Biologicheskikh Struktur, Nauka Press, Moscow, 1972. 71p. Dep. NTIS $5.75.

7653 (AEEW-M-1150) SHORT-TERM COLLAPSE OF TUBES UNDER EXTERNAL PRESSURE. Stevens, G. F. W. (Atomic Energy Establishment, Winfrith (England)). Nov 1972. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

This note presents some experimental results on short-term collapse of stainless steel tubes under external pressure, and compares the results with a published theory. The tubes used in the experiments were of 25/20 stainless steel. The theory is used to predict the collapse pressure of 18/8/1 stainless steel tubes which are commonly used in heat transfer research. (auth)

7654 (ANL/ES-24) EFFECTIVENESS OF A HYPOTHETICAL AIR POLLUTION EPISODE-CONTROL STRATEGY FOR TWO CHICAGO EPISODES. Wangler, T. P.; Rossin, A. D. (Argonne National Lab., Ill.). Jan 1973. Contract W-31-109-Eng-38. 64p. Dep. NTIS $5.45.

7655 (ANL-Trans-940) REASON FOR THE NATURE OF THE FIRST RESONANCE IN THE EXCITATION OF BENZENE BY ELECTRON COLLISION. Ioganson, L. B. Translated from Teor. Eksp. Khim.; 8: No. 3, 419-420(1972). 5p. Dep. NTIS $3.00.

7656 (BDX-613-716(Rev.)) QUALIFICATION OF MINIATURE INTERNAL THREADS USING AIR FLOW. Berry, C. W. Jr. (Bendix Corp., Kansas City, MO). Apr 1973. Contract AT(29-1)-613. 23p. Dep. NTIS $4.00.

The air gaging of blind and through-type miniature threaded holes has proven feasible. Additional work is required to determine flow limits for acceptable parts and to adapt air measurements to specific part configurations. (auth)

7657 (BDX-613-773) ELECTRICAL TERMINATIONS: WELDED, BRAZED, AND BONDED, FY72-4. Quarterly Report. Stittsworth, D. E. (Bendix Corp., Kansas City, MO). Mar 1973. Contract AT(29-1)-613. 35p. Dep. NTIS $4.00.

A prototype alternating-current pulse-arc power supply was fabricated and various types of in-process monitor systems for opposed-electrode welding were tested. In addition, evaluations were performed on an ultrasonic weld system and a prototype percussive-arc actuator. Hydrogen embrittlement tests for detection of cuprous oxide within copper wire were adapted to small gage wire used on pulse-arc welded configurations. Electroless nickel was evaluated for use as a braze alloy on parallel-gap brazing applications. (auth)

7658 (BDX-613-869) FABRICATION OF OPEN CELL POLYETHYLENE FOAM. Technological Spinoff Report. Fossey, D. J. (Bendix Corp., Kansas City, MO). Mar 1973. 24p. Dep. NTIS.

Open cell polyethylene foam was fabricated using sodium chloride as the pore-former. A solvent blending/leaching process was used that allowed easy control of cell size and open cell content. (auth)

7659 (BDX-613-877) MICROHM DECADE RESISTOR. Special Spinoff Report. Kator, G. E. (Bendix Corp., Kansas City, MO). May 1973. Contract AT(29-1)-613. 16p. Dep. NTIS $3.00.

A microhm decade resistor with a minimum resolution of 1 microhm per step has been designed and built at Bendix Kansas City Division. Waidner–Wolff (or shunted) decades provided the desired small incremental changes in resistance. (auth)

7660 (BLG-474) BEHAVIOUR OF A HELIUM CRYOSTAT FOR THE MEASUREMENT OF THE MAGNETIC SUSCEPTIBILITY BY THE FARADAY METHOD. Vansummeren, J.; Van den Bosch, A. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium)). Sep 1972. 26p. Dep. NTIS (U. S. Sales Only) $3.50.

A metallic helium cryostat was constructed and adapted to an apparatus for precise measurement of the magnetic susceptibility by the Faraday method. Its refrigerant vessel has a capacity of 1.9 litre. When filled with liquid helium, a sample can be kept at 4.5°K for 9 hours. The dewar tail fits a 1-inch gap between the pole pieces of a 12-inch Varian electromagnet. (MOW)

7661 (BNL-17748) RESOLUTION OF CRYSTALLOGRAPHIC DISORDER BY COUPLED SINGLE CRYSTAL X-RAY-DIFFRACTION AND MOESSBAUER SPECTROSCOPY: STUDY OF THE (π-(1)-2-THIOLLYL) IRON(II) SYSTEM. Davis, B. R.; Bernal, I.; Buttone, J.; Good, M. L. (Brookhaven National Lab., Upton, N. Y.; Louisiana State Univ., New Orleans). 1972. 9p. (CONF-730117-2). Dep. NTIS $3.00.

From 8th Mossbauer symposium; New York, New York, USA (28 Jan 1973).

7662 (BNL–17761) FIRE TESTS OF HALON 1301 EXTINGUISHING SYSTEMS FOR USE IN INSTRUMENT TRAILERS. Final Report. Deitz, J. B. (Brookhaven National Lab., Upton, N. Y.). 13 Mar 1973. 36p. Dep. NTIS $4.00.

A series of six fire tests was conducted of a prototype Halon 1301 fire-extinguishing system for use in Brookhaven National Laboratory instrument trailers. Test fires included methyl alcohol, kerosene, a wood crib, and electrical equipment. The test trailer volume was 3200 cubic feet. Of primary interest was the effectiveness of the system in limiting fire loss potentials, and the levels of Halon 1301 decomposition products (primarily HF) produced by the various test fires. As a result of the tests, the prototype system was judged effective as a fire-extinguishing system. Halon 1301 concentrations were about 8%. Using a 12-second discharge time, on a 4 sq. ft. methyl alcohol fire, a peak concentration of approximately 550 ppm HF was produced. When the discharge time was reduced to 8 seconds, with the same methyl alcohol fire, the peak HF concentration was approximately 350 ppm. The kerosene and electrical fires produced HF concentrations of less than 10 ppm. A peak of approximately 40 ppm was produced from the wood crib fire. When a risk-benefit analysis was conducted, the recorded levels of Halon 1301 decomposition were not considered a serious personnel hazard for most BNL trailer installations. (auth)

7663 (BNL-17765) REACTION OF HALOCARBONS WITH PHOTOCHEMICALLY GENERATED HYDROGEN ATOMS. MacKenzie, D. R.; Graham, L. (Brookhaven National Lab., Upton, N. Y.). Dec 1972. 24p. Dep. NTIS $3.25.

7664 (BNL-17772) LEAST MOTION ANALYSIS OF REACTION PATHWAYS. Ehrenson, S. (Brookhaven National Lab., Upton, N. Y.). 1973. 36p. (CONF-730418-1). Dep. NTIS $4.00.

From 6th symposium on quantum chemistry and biochemistry; Jerusalem, Israel (9 Apr 1973).

7665 (BNL-tr-528) OCCURRENCE OF SILVER IN GALENAS IN SOME ARMENIAN DEPOSITS. Paronikyan, V. O. Translated from Zap. Vses. Mineral. Obshchest.; 96: No. 4, 456-459(1967). 9p. Dep. NTIS $3.00.

7666 (BNWL-1743) EVALUATION OF FOUR PSEUDO-RANDOM NUMBER GENERATORS. Gilbert, R. O. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1973. Contract AT(45-1)-1830. 61p. Dep. NTIS $5.25.

7667 (BNWL-SA-4476) SYNERGISTIC ADDITIVES WHICH ENHANCE COPPER EXTRACTION WITH LIQUID ION EXCHANGERS. Moore, R. H.; Partridge, J. A. (Battelle Pacific Northwest Labs., Richland, Wash.). Nov 1972. 20p. (CONF-721214-1). Dep. NTIS.

From 78th annual mining conference; Spokane, Washington, USA (1 Dec 1972).

7668 (BNWL-SA-4499) MINICOMPUTER CONTROLLED AMMUNITION CASE SURFACE FLAW INSPECTION SYSTEM. Erickson, M. D.; Compton, M. R. (Battelle Pacific Northwest Labs., Richland, Wash.). 1973. 19p. (CONF-730508-2). Dep. NTIS $3.00.

From 6th conference on minicomputers and their applications; Honolulu, Hawaii, USA (2 May 1973).

A prototype case surface flaw inspection unit based on optical scattering instrumentation was developed for 5.56-mm cartridge cases. This unit includes a system for feeding and handling cases at a rate up to 1200 cases per minute, a computer-based inventory and process control system, optical flaw instrumentation, and process control instrumentation. A dedicated computer is necessary to acquire data on-line in real time and provide rapid data output suitable for process operator decision making. Future use of this measurement system will include output of flaw data to a larger host computer for more sophisticated data analysis and integration with the total process data base. (auth)

7669 (BNWL-SA-4635) OBSERVED INCREASE IN THERMAL TOLERANCE OF FISH CAUSED BY INDUCED PIGMENT ADJUSTMENT. Emery, R. M. (Battelle Pacific Northwest Labs., Richland, Wash.). Feb 1973. 12p. (CONF-730505-1). Dep. NTIS $3.00.

From thermal ecology symposium; Aiken, South Carolina, USA (3 May 1973).

7670 (CEA-CONF-2134) BUBBLE DOMAIN MEMORY MATERIALS. Challeton, D.; Coeure, P.; Daval, J.; Mareschall, J.; Mathiot, A. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 25 Sep 1972. 36p. (CONF-720989-1). Dep. NTIS (U. S. Sales Only) $4.00.

From 1st European exhibition and conference on electro-optical markets and technology; Geneva, Switzerland (12 Sep 1972).

Properties required of the materials, available materials, techniques to test the materials, and bubble manipulation are described. It is premature to give a single material pre-eminence over all others; however, the noncubic garnets are extremely attractive because of their feasibility of growing thin films. But much work remains to elaborate thin films, free of defects, useful in the devices. (15 figures, 38 references) (auth)

7671 (CEA-CONF-2172) APPLICATION OF LINEAR FLUORESCENCE TO THE STUDY OF PIGMENTS IN MONOMOLECULAR LAYERS. Breton, J.; Michel-Villaz, M.; Paillotin, G.; Vandevyver, M. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1972. 9p. (In French). (CONF-720568-3). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on thin films; Venice, Italy (15 May 1972).

7672 (CEA-CONF-2183) PROGRAM APEX. Experimental and Theoretical Studies of Crater Dimensions of Chemical Explosions in Some Soils. Gautier, J.; Perroud, P. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Mar 1972. 45. (In French). (CONF-721108-8). Dep. NTIS (U. S. Sales Only) $4.25.

7673 (CEA-CONF-2207) PERSPECTIVES IN ELECTRONYSTAGMOGRAPHY BY ELECTRONICS. Max, J. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 25 Aug 1972. 28p. (In French). (CONF-720991-1). Dep. NTIS (U. S. Sales Only) $3.50.

From conference on clinical vestibulometry; Strasbourg, France (25 Sep 1972).

7674 (CEA-CONF-2208) ELECTRONIC EQUIPMENT FOR ELECTRONYSTAGMOGRAPHY. Max, J.; Despringre, A.; Conraux, C. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 1 Sep 1972. 29p. (In French). (CONF-720991-2). Dep. NTIS (U. S. Sales Only) $3.50.

From Conference on Clinical Vestibulometry; Strasbourg, France (25 Sep 1972).

7675 (CEA-R-4421) EFFECT OF LACTOSE ON INTESTINAL ABSORPTION OF CALCIUM. Labat, M. L. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1973. 168p. (In French). Dep. NTIS (U.S. Sales Only) $10.50.

Thesis.

7676 (CEA-R-4438) NEW METHOD FOR QUANTIFYING THE VALUE OF INNOVATIONS. Thiriet, L. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Feb 1973. 35p. (In French). Dep. NTIS (U. S. Sales Only) $3.75.

7677 (CGS-746-108) ALEUTIAN SEISMIC PROGRAM. Seismological Bulletin, June 1970. (National Ocean Survey, Rockville, MD). Feb 1971. Contract AT(29-2)-746. 80p. Dep. NTIS $6.00.

7678 (CGS-746-115) IMPROVED BODY-WAVE MAGNITUDES OF ALEUTIAN EARTHQUAKES. Tarr, A. C. (National Ocean Survey, Rockville, Md.). May 1971. Contract AT(29-2)-746. 47p. Dep. NTIS $4.50.

Uncertainties in routine PDE mb estimates of Aleutian earthquake magnitudes often reflect the effects of station-source region biases and station detection-threshold magnitudes. Examination of magnitude data from aftershocks of the February 27, 1970, Aleutian Trench earthquake indicates that magnitudes of small aftershocks were consistently underestimated, since these events were observed primarily by Western United States stations having negative biases. The same general pattern is observed elsewhere in the Aleutian arc. Quantitative estimates of the station-source region biases using over five years of short-period P amplitude data confirm these observations. Correction for the station-source region bias significantly reduces the dispersion of station magnitudes about the mean and, in some cases, shifts the mean by as much as 0.3 magnitude unit. (auth)

7679 (CONF-730105-3) PRECISION EMF MEASUREMENTS ON PROTOLYTIC EQUILIBRIA WITH THE HYDROGEN ELECTRODES ABOVE 100°C. Mesmer, R. E.; Sweeton, F. H.; Hitch, B. F.; Baes, C. F. Jr. (Oak Ridge National Lab., Tenn.). 1972. 34p. Dep. NTIS.

7680 (CONF-730206-3) NEW SMALL PROTEINS ASSOCIATED WITH DNA-DEPENDENT RNA POLYMERASE OF E. COLI AFTER INFECTION WITH T4 PHAGE. Stevens, A.; Crowder, R. D. (Oak Ridge National Lab., Tenn.). 1972. 31p. Dep. NTIS $3.75.

From International Symposium on Control of Transcription; Calcutta, India (12 Feb 1973).

7681 (CONF-730206-4) TRANSCRIPTIONAL CONTROL OF M13 PHAGE DNA REPLICATION. Mitra, S. (Oak Ridge National Lab., Tenn.). 1972. 20p. Dep. NTIS $3.00.

From International symposium on control of transcription; Calcutta, India (12 Feb 1973).

7682 (CONF-730317-2) DEVELOPMENT OF AN ANALYTICAL SYSTEM BASED AROUND A MINIATURE FAST ANALYZER. Burtis, C. A.; Johnson, W. F.; Mailen, J. C.; Overton, J. B.; Tiffany, T. O.; Watsky, M. B. (Oak Ridge National Lab., Tenn.). 1973. 50p. Dep. NTIS $4.50.

From 5th annual symposium on advanced concepts for the clinical laboratory; Oak Ridge, Tennessee, USA (15 Mar 1973).

7683 (CONF-730323-1) MODELS, DIVERSE SKILLS, AND THE REAL WORLD. Meyers, C. R. Jr. (Oak Ridge National Lab., Tenn.). 1973. 9p. Dep. NTIS $3.00.

From Symposium on land-use planning and control; Ames, Iowa, USA (15 Mar 1973).

Some factors or questions involved in the ability to predict land usage and its associated environmental impacts, both in an assumed steady state and in the presence of real or imagined perturbation, are discussed. (MOW)

7684 (CONF-730332-1) FETAL ANTIGENS IN NEOPLASIA. Hanna, M. G. Jr.; Salinas, F. A.; Coggin, J. H. Jr. (Oak Ridge National Lab., Tenn.; Tennessee Univ., Knoxville. Dept. of Microbiology). 1973. 34p. Dep. NTIS $3.75.

7685 (CONF-730419-1) DATA ACQUISITION SYSTEM FOR ECOLOGICAL FIELD STUDIES. Martin, C. D.; Hutton, J. T.; Simpson, R. L. (Oak Ridge National Lab., Tenn.). 1973. 4p. Dep. NTIS $3.00.

From 8th annual conference on the use of digital computers in process control; Knoxville, Tennessee, USA (16 Apr 1973).

7686 (CONF-730423-1) REGIONAL DIFFERENCES IN THE GROWTH OF OVERNIGHT TRUCK TRANSPORT MARKET AREAS, 1950–1970. Olsen, R. J.; Westley, G. W. (Oak Ridge National Lab., Tenn.). 1973. 15p. Dep. NTIS $3.00.

From Southern Regional Science Association meetings; New Orleans, Louisiana, USA (26 Apr 1973).

7687 (CONF-730423-3) POLLUTION, PRODUCTION, AND COMPENSATION. Patrick, C. H. (Oak Ridge National Lab., Tenn.). 1972. 15p. Dep. NTIS $3.00.

From Southern Regional Science Association meetings; New Orleans, Louisiana, USA (26 Apr 1973).

7688 (CONF-730426-1) REGIONAL DIFFERENCES IN THE GROWTH OF MARKET POTENTIALS, 1950–1970. Olsen, R. J.; Westley, G. W. (Oak Ridge National Lab., Tenn.). 1973. 14p. Dep. NTIS $3.00.

From Mid-continent Regional Science Association meetings; Stillwater, Oklahoma, USA (13 Apr 1973).

7689 (CONF-730509-1) USE OF SEQUENTIAL COLUMNS OF MICRORETICULAR AND PELLICULAR ION EXCHANGE RESINS IN THE HIGH-RESOLUTION SEPARATION OF COMPLEX BIOCHEMICAL MIXTURES. Scott, C. D.; Lee, N. E. (Oak Ridge National Lab., Tenn.). 1973. 19p. Dep. NTIS $3.00.

From 1st international symposium on column liquid chromatography; Interlaken, Switzerland (2 May 1973).

7690 (CONF-730513-1) HYPERFILTRATION (REVERSE OSMOSIS) OF KRAFT PULP MILL AND BLEACH PLANT WASTES. Johnson, J. S. Jr.; Minturn, R. E.; Moore, G. E. (Oak Ridge National Lab., Tenn.). 1973. 9p. Dep. NTIS $3.00.

From Environmental conference of the Technical Association of the Pulp and Paper Industry; San Francisco, California, USA (16 May 1973).

7691 (CONF-730519-1) DYNAMICALLY FORMED MEMBRANES IN ULTRAFILTRATION AND HYPERFILTRATION OF EFFLUENTS. Johnson, J. S., Jr. (Oak Ridge National Lab., Tenn.). 1973. 16p. Dep. NTIS $3.00.

From National Science Foundation Membrane symposium; Cleveland, Ohio, USA (8 May 1973).

7692 (CONF-730613-1) PRESERVATION OF DILUTE MERCURY SOLUTIONS. Feldman, C. (Oak Ridge National Lab., Tenn.). 1971. 12p. Dep. NTIS $3.00.

From 7th annual conference on trace substances in environmental health; Columbia, Missouri, USA (12 Jun 1973).

Distilled water solutions containing 0.1 to 10.0 ng Hg/ml were stored for 10 days in glass and polyethylene containers. Those which were untreated, or treated with HNO_3, H_2SO_4 + $KMnO_4$, or $K_2Cr_2O_7$ lost substantial fractions of their mercury in this period. Solutions stored in polyethylene and treated with 5% (v/v) HNO_3 + 0.05% $Cr_2O_7^{-2}$ stayed at full strength for at least ten days. Solutions stored in glass and treated with 5% (v/v) HNO_3 + 0.01% $Cr_2O_7^{-2}$ stayed at full strength for as long as 5 months. The causes of losses in distilled and natural water samples are discussed. (auth)

7693 (COO-875-155) ENERGY TRANSFER MECHANISMS IN PHOTOBIOLOGICAL REACTIONS. Technical Progress Report, August 1, 1972–April 30, 1973. Spikes, J. D. (Utah Univ., Salt Lake City). 1 May 1973. Contract AT(11-1)-875. 8p. Dep. NTIS $3.00.

7694 (COO-910-29) BOVINE LYMPHOCYTIC LEUKEMIA: STUDIES OF ETIOLOGY, PATHOGENESIS, AND MODE OF TRANSMISSION. Progress Report, July 1972–July 1973. Sorensen, D. K. (Minnesota Univ., St. Paul. Coll. of Veterinary Medicine). 30 Apr 1973. Contract AT(11-1)-910. 26p. Dep. NTIS $3.50.

7695 (COO-1495-22) MOVEMENT OF STRONTIUM THROUGH THE SOIL TO THE PLANT ROOT MEMBRANE. Progress Report, September 1, 1972–August 31, 1973. Barber, S. A.; Malzer, G. L. (Purdue Univ., Lafayette, Ind.). 1973. Contract AT(11-1)-1495. 32p. Dep. NTIS $3.75.

7696 (COO-1515-46) IRON OXIDATION AND REDUCTION EFFECTS ON STRUCTURAL HYDROXYL AND LAYER CHARGE IN AQUEOUS SUSPENSIONS OF BIOTITIC VERMICULITES. Veith, J. A.; Jackson, M. L. (Wisconsin Univ., Madison). 1972. 31p. Dep. NTIS $3.75.

7697 (COO-1633-24) STRUCTURE AND SYNTHESIS OF SMALL VIRUSES AND THEIR COMPONENT PARTS. Progress Report, February 16, 1972–February 16, 1973. Kaesberg, P. (Wisconsin Univ., Madison. Biophysics Lab.). [nd]. Contract AT(11-1)-1633. 27p. Dep. NTIS $3.50.

7698 (COO-1680-18) EXCHANGE OF INTERLAYER CATIONS IN MICACEOUS MINERALS. Progress Report, February 1, 1972-July 31, 1973. Scott, A. D. (Iowa State Univ. of Science and Technology, Ames). 1973. Contract AT(11-1)-1680. 4p. Dep. NTIS $3.00.

A basis for studying indigenous interlayer Cs exchange was established by surveying the Cs content of micas and modifying the exchange procedures. (JGB)

7699 (COO-1680-19) EXCHANGE OF INTERLAYER CATIONS IN MICACEOUS MINERALS. Summary Report, February 1, 1970-July 31, 1973. Scott, A. D. (Iowa State Univ. of Science and Technology, Ames). 1973. Contract AT(11-1)-1680. 27p. Dep. NTIS $3.50.

Diverse activities required by the broad scope of this project and the accomplishments of the past three years are summarized in terms of seven lines of work: (1) a survey of the Cs content of micas led to a comparison of the distribution and exchangeability of indigenous Cs, Rb and K in the same sample; (2) methods of adding interlayer Cs were evaluated, and the exchangeability of added and indigenous Cs in various minerals was compared; (3) effects of heat treatments on the exchangeability of K in coarse and fine-grained micaceous minerals were determined and related to properties of the mineral, a relationship between K exchangeability and muscovite dehydroxylation being established; (4) the rate of K exchange in micas was increased by adding H_2O_2 to the solution, but no oxidation of Fe in the mica or exfoliation occurred; (5) the reaction temperature was shown to have an effect on the rate, degree, and mode of interlayer K release; (6) the limited exchange of K in small mica particles was overcome by using low mineral/solution ratios; and (7) new procedures were developed. (auth)

7700 (COO-2101-13) SYNTHESIS OF DNA CONTAINING URACIL OR 5-HYDROXYMETHYLURACIL DURING BACTERIOPHAGE INFECTION OF BACILLUS SUBTILIS. Progress Report, August 1, 1972–July 31, 1973. Price, A. R. (Michigan Univ., Ann Arbor. Dept. of Biological Chemistry). 1973. Contract AT(11-1)-2101. 8p. Dep. NTIS $3.00.

7701 (COO-2101-14) SYNTHESIS OF DNA CONTAINING URACIL OR 5-HYDROXYMETHYLURACIL DURING BACTERIOPHAGE INFECTION OF BACILLUS SUBTILIS. Comprehensive Report, May 1, 1970–July 31, 1973. Price, A. R. (Michigan Univ., Ann Arbor. Dept. of Biological Chemistry). 1973. Contract AT(11-1)-2101. 6p. Dep. NTIS $3.00.

7702 (COO-2111-3) ENVIRONMENTAL FACTORS AND REPRODUCTIVE PROCESSES IN MAMMALIAN POPULATIONS. Negus, N. C.; Berger, P. J. (Utah Univ., Salt Lake City. Dept. of Biology). 1972. 32p. (CONF-720348–1). Dep. NTIS $3.75.

From 3rd international congress of anatomists; New Orleans, Louisiana, USA (Mar 1972).

7703 (COO-2249-2) TRANSPORT PROCESSES AND TRACE CONSTITUENTS IN THE STRATOSPHERE. Progress Report for the Period November 20, 1972–June 30, 1973. Cunnold, D. M. (Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology). 2 Apr 1973. Contract AT(11-1)-2249. 91p. Dep. NTIS $6.75.

7704 (COO-3016-1) STUDIES ON MECHANISMS OF MUTATION, RECOMBINATION, AND GENE ACTION IN NEUROSPORA. Final Technical Report. Giles, N. H. (Yale Univ., New Haven, Conn.). 1972. Contract AT(11-1)-3016. 6p. Dep. NTIS $3.00.

7705 (COO-3028-3) EFFECTS OF SURFACE-ACTIVE MATERIALS ON THE OSCILLATIONS OF A LIQUID JET. Quinn, G. P.; Saville, D. A. (Princeton Univ., NJ. Dept. of Chemical Engineering). 1972. Contract AT(11-1)-3028. 27p. Dep. NTIS $3.50.

The oscillatory motion and stability of a liquid jet are examined in the context of a theory which accounts for local variations of interfacial tension induced by expansion and contraction of an interface containing adsorbed molecules. The presence of a soluble surfactant alters the oscillation frequency as well as growth and decay rates via damping in a boundary layer. It is found that the frequency alteration is a substantial effect when considered in the context of measurements made with oscillating jets, i.e., the dynamic surface tension. When viscous effects are large the presence of surfactant may introduce oscillatory character in place of the aperiodic behavior of pure liquids. (auth)

7706 (COO-3120-3-A) WAVELENGTH DEPENDENCE OF CATHODE NONUNIFORMITIES IN IMAGE INTENSIFIERS. Technical Report 14. Reynolds, G. T.; Botos, P. Jr.; Gruner, S. (Princeton Univ., N. J. Joseph Henry Labs.). 3 Jan 1973. Contract AT(11-1)-3120. 8p. Dep. NTIS $3.00.

7707 (COO-3120-4) BIOLUMINESCENT SPECTRA OBSERVED IN VIVO BY MEANS OF AN IMAGE INTENSIFIER SPECTROMETER. Technical Report 15. Reynolds, G. T. (Princeton Univ., N. J. Joseph Henry Labs.). 23 Jan 1973. Contract AT(11-1)-3120. 52p. Dep. NTIS $4.75.

7708 (COO-3139-5) PROTEINS IN GROWTH REGULATION DURING EARLY DEVELOPMENT OF THE CHICK EMBRYO. Progress Report, May 1972–May 1973. Klein, N. W. (Connecticut Univ., Storrs. Dept. of Animal Genetics). 1973. Contract AT(11-1)-3139. 31p. Dep. NTIS $3.75.

7709 (COO-3139-7) PROTEIN NUTRITION IN GROWTH REGULATION DURING EARLY DEVELOPMENT. Klein, N. W. (Connecticut Univ., Storrs. Dept. of Animal Genetics). 1973. Contract AT(11-1)-3139. 71p. Dep. NTIS $5.75.

7710 (COO-3334-2) THERMAL AND EPITHERMAL NEUTRONS IN THE TREATMENT OF NEOPLASMS. Technical Progress Report, May 1, 1972–April 30, 1973. Sweet, W. H. (Massachusetts General Hospital, Boston). 1 May 1973. Contract AT(11-1)-3334. 43p. Dep. NTIS $4.25.

7711 (COO-3390-7) ROLE OF PLANKTONIC PROTOZOA IN THE MARINE FOOD CHAIN. Seasonal Changes, Relative Abundance, and Cell Size Distribution of Tintinnida. Progress Report, May 1, 1972–April 30, 1973. Gold, K. (New York Aquarium, Brooklyn. Osborn Labs. of Marine Sciences). 1973. Contract AT(11-1)-3390. 18p. Dep. NTIS $3.00.

7712 (COO-3516-2) MITOCHONDRIAL PHENOTYPES AND GENOTYPES IN YEAST. Technical Annual Progress Report, August 1, 1972-July 31, 1973. Avers, C. J. (Rutgers-The State Univ., New Brunswick, N. J.). 1973. Contract AT (11-1)-3516. 4p. Dep. NTIS $3.00.

7713 (CSIRO-Trans-11247) STUDY AND DESIGN OF THE SYNCHRONOUS OSCILLATORS OF A RADIOASTRONOMICAL INTERFEROMETER FOR 35 GHz. Charru, A.; Mallet, J. P.; Perrin, J. Cl.; Pichcrit, P.; Trezeguet, J. P. Translated by G. Losonci from Onde Elec.; 50: No. 6, 517-523(1970). 16p. Dep. NTIS (U. S. Sales Only) $3.00.

An analysis was made of the operation of each microwave section of a 35-GHz interferometer for solar studies. A simulated variation of the frequency of oscillator K_0 does not disturb the phase-locking of K_0 and K_1. Frequency variation of K_0 does not exceed kHz within a day and the phase lock "follows" perfectly, as it can correct frequency variations to 20 MHz. The phase synchronization is maintained indefinitely and random residual phase variations between the 2 synchronous oscillators are under 10°. (AT)

7714 (DUN-SA-200) PROTECTION OF SYNCHRONOUS MOTORS FOR OUT-OF-STEP OPERATION DURING A POWER SYSTEM DISTURBANCE. Thorson, W. R. (Douglas United Nuclear, Inc., Richland, Wash.). 26 Apr 1973. 13p. (CONF-730430-1). Dep. NTIS $3.00.

From IEKE paper contest; Richland, Washington, USA (26 Apr 1973).

Conventional out-of-step relaying for synchronous motors is not adequate protection for synchronous machines operating on a power system following a severe power-system disturbance. A fast and reliable relay which operates on the motor real power function can be applied to provide high-speed relay action that will function for any kind of power-system disturbance that causes an out-of-step motor action. (auth)

7715 (EUR-4943) 13TH 1971 METEOROLOGICAL YEARBOOK. Bollini, G.; Gandino, C. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Mar 1973. 72p. (In Italian). Dep. NTIS (U. S. Sales Only) $5.75. EUR FB 100,-.

After a short description of the methods for measuring and elaborating atmospheric phenomena, many tables and graphics for the meteorological year 1971 are reported with English titles included. With the Observatory's data, temperature measurements at screen No. 4, 45 meters lower, the flow of the Novellino brook, and 4 tables with the stability categories are added. (auth)

7716 (IFA-R-2-1972) SPATIAL FILTERING SYSTEM FOR HANDLING SEISMIC DATA. Vasiliu, V.; Apostol, D.; Maris, Z. (Institutul de Fizica Atomica, Bucharest (Romania)). 1972. 13p. Dep. NTIS (U. S. Sales Only) $3.00.

An optical system is described for performing the spatial filtering of seismic data. The experimental setup is based on a Fourier transform which is achieved by a spherical mirror. The technique and the experimental results of spatial filtering are presented. (auth)

7717 (IS-3101) MODIFICATION AND OPERATION OF A KNUDSEN EFFUSION APPARATUS. Justice, B. H. (Ames Lab., Iowa). Mar 1973. Contract W-7405-eng-82. 15p. Dep. NTIS $3.00.

A summary is given of the progress made in modifying the Knudsen-effusion apparatus first reported by Smythe (Thesis, 1958) and modified by others. It was felt that the 2nd- and 3rd-law heats of vaporization could be made to agree better than previous reports. The major objective then was to modify the effusion apparatus and check its validity with magnesium. Continued measurements on rare earth–magnesium are planned. (auth)

7718 (IS-T-569) POLARIZED CRYSTAL ABSORPTION SPECTRA FOR DIBROMO(ETHYLENEDIAMINE) PLATINUM (II). Kroening, R. F. (Ames Lab., Iowa). Feb 1973. Contract W-7405-eng-82. 60p. Dep. NTIS $5.00.

Thesis.

7719 (ITF-72-186-P) APPLICATION OF A METHOD OF IRREDUCIBLE TENSOR OPERATORS TO THE INVESTIGATION OF ONE-PARTICLE ELECTRIC DIPOLE TRANSITIONS IN ANTIFERRODIELECTRICS. Petrov, E. G.; Kharkyanen, V. N. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 23p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

A method of irreducible tensor operators is used to construct a theory of one-particle spin-forbidden electric-dipole transitions between the ground and excited states of the even 3d shell of a magnetic ion in an antiferrodielectric. The theory allows the contribution of intermediate states of all odd configurations to an electric-dipole transition to be taken into account semiphenomenologically. (tr-auth)

7720 (ITF-72-187-P) EQUILIBRIUM FIGURES OF AN IDEAL ROTATING LIQUID IN THE POST-NEWTONIAN APPROXIMATION OF GENERAL RELATIVITY. Piragas, K. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 22p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.25.

A stability criterion is given for the equilibrium form of an ideal rotating liquid in the post-Newtonian approximation. This generalizes the known Liapunov criterion in classical dynamics. (auth)

7721 (ITF-73-1-P) CONFIGURATIONAL CHANGES AND OPTICAL PROPERTIES OF ALPHA-HELICAL PROTEIN MOLECULES. Davydov, A. S.; Suprun, A. D. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 14p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

7722 (ITF-73-10-P) LIGHT ABSORPTION BY CRYSTALS WITH SPACE DISPERSION. Davydov, A. S.; Eremko, A. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 28p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

The phenomenologic theory of light absorption by crystals is considered on the basis of the Maxwell equations. The additional strange currents on a crystal surface that are expressed via stresses of the fields falling on a crystal surface are used in calculations. This allows without introducing subsidiary boundary conditions for examination of the light passing through the crystal and its reflection from a surface. The conditions at which one can elucidate the peculiarities associated with space dispersion of dielectric permeability are obtained. A consideration is also made of the case of time change of a space homogeneous electromagnetic field in a crystal. (tr-auth)

7723 (JINR-E12-6773) CORRELATION BETWEEN THE OVERALL STABILITY CONSTANTS OF METAL COMPLEXES. II. Application to Data Obtained by the Polarographic Method for Metal-Inorganic Ligand Systems. Mihailov, M. H.; Mihailova, V. Ts.; Khalkin, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 16p. Dep. NTIS (U. S. Sales Only).

7724 (JINR-E12-6775) CORRELATION BETWEEN THE OVERALL STABILITY CONSTANTS OF METAL COMPLEXES. IV. Copper Methoxyacetate, Copper-Ethoxyacetate, Copper Thiodiacetate, Cadmium-Ethoxyacetate, and Cadmium (Ethylthio) Acetate Systems. Mihailov, M. H.; Mihailova, V. Ts.; Khalkin, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 15p. Dep. NTIS (U. S. Sales Only).

7725 (JINR-E12-6776) CORRELATION BETWEEN THE OVERALL STABILITY CONSTANTS OF METAL COMPLEXES. V. Nickel-Ethoxyacetate, Nickel-(Ethylthio)Acetate and Lead-Ethoxyacetate Systems. Mihailov, M. H.; Mihailova, V. Ts.; Khalkin, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 17p. Dep. NTIS (U. S. Sales Only).

7726 (JINR-P4-6985) CALCULATION OF THE ASPHERICITY OF MAGNETIC FORM FACTORS IN THE SYSTEM $Ni_{1-x}Fe_x$ USING THE COHERENT POTENTIAL APPROXIMATION. Elk, K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 11p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

7727 (JPRS-58783) ELECTROMAGNETIC RADIATION SAFETY. Krylov, V. A.; Yuchenkova, T. V. Translation of Zashchita ot Elektromagnitnykh Izlucheniy, 1972, Moscow. 190p. NTIS $11.50.

7728 (JUL-911-AC) TECHNIQUES AND MATERIALS IN MICRO AND TRACE ANALYSIS. I. Constant Weight and Water Permeability Tests of Polyolefinic Vials. Ameln, F. V.; Belouadah, A.; Stoeppler, M. (Kernforschungsanlage, Juelich (West Germany). Zentralinstitut fuer Analytische Chemie). Dec 1972. 37p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

7729 (KY-647) REDUCTION OF HEXAVALENT CHROMIUM IN PADUCAH PLANT COOLANT WATER WITH SULFUR DIOXIDE. Cook, G. T.; Simmons, R. E. (Paducah Gaseous Diffusion Plant, KY). 4 Apr 1973. Contract W-7405-eng-26. 13p. Dep. NTIS $4.00.

Sulfur dioxide is shown to be effective for reducing hexavalent chromium to 0.05 ppM or less in Paducah Plant recirculating coolant water. The influence of variables such as temperature, pH, and sulfur dioxide concentration on the reduction efficiency is given. Information concerning removal of the reduced chromium with lime and the effect of sulfur dioxide on the dissolved oxygen content of the water is also presented. (auth)

7730 (LA-5235-MS) CONTINUOUS CRYSTALLIZATION OF HIGH EXPLOSIVES. Hatler, L. E. (Los Alamos Scientific Lab., N. Mex.). Apr 1973. Contract W-7405-eng-36. 19p. Dep. NTIS $3.00.

7731 (LA-5246-MS) DETERMINATION OF TRICHINELLAE IN PORK. Giles, P. M. (Los Alamos Scientific Lab., N. Mex.). Apr 1973. Contract W-7405-eng-36. 7p. Dep. NTIS $3.00.

Developments at the Los Alamos Scientific Laboratory (LASL) in the detection of trichinellae in pork indicate that rapid sampling of slaughterhouse animals may be practical and economical by relatively simple procedures. The projection and digestion methods are described separately. (auth)

7732 (LA-UR-73-61) POLYMERIC PRECURSORS OF CARBON. Wewerka, E. M. (Los Alamos Scientific Lab., N. Mex.). 1973. 6p. (CONF-730507-2). Dep. NTIS $3.00.

From American Chemical Society; Detroit, Michigan, USA (1 May 1973).

A review is presented to illustrate some of the ways that polymers and polymer chemistry contribute to the broad field of carbon technology. Emphasis is given to polymeric precursors and intermediates that form graphites and amorphous carbons. Basic behavioral differences between thermosetting and thermoplastic polymers during carbonization and heat treatment are detailed. Thermosetting polymers are discussed as starting materials for such carbon products as molecular sieves, foams, and amorphous carbons. The use of thermosetting polymers as binder materials in the fabrication of bulk graphite artifacts is also considered. Both thermosetting and thermoplastic polymer fibers are shown to be precursors for carbon fibers. The general and broad use of thermoplastic coal-tar-pitch graphite binders is noted. Recent studies of the carbonization of thermally stable polymers are discussed. (46 references) (auth)

7733 (LA-UR-73-62) GRAPHITE BINDERS FROM AROMATIC-HYDROCARBON POLYMERS. Williams, J. M.; Wewerka, E. M.; Imprescia, R. J. (Los Alamos Scientific Lab., N. Mex.). 1973. 6p. (CONF-730507-3). Dep. NTIS $3.00.

From American Chemical Society; Detroit, Michigan, USA (1 May 1973).

7734 (LA-UR-73-69) GENERATION OF SINGLE NANOSECOND PULSES AT 10.6 μ USING A BREWSTER-ANGLE ACOUSTO-OPTIC MODULATOR. Figueira, J. F.; Singer, S.; Foley, E. (Los Alamos Scientific Lab., N. Mex). 1973. 5p. (CONF-730515-1). Dep. NTIS $3.00.

From fourth biennial conference on laser engineering and applications; Washington, District of Columbia, USA (30 May 1973).

7735 (LA-UR-73-471) NEW METHODS OF EED RF TESTING. Joppa, R. M.; Freyman, R. W. (Los Alamos Scientific Lab., N. MEX). 1973. 13p. (CONF-730615-1). Dep. NTIS $3.00.

From international symposium on electromagnetic compatibility; New York, New York, USA (20 Jun 1973).

The use of impedance data, obtained nondestructively through the use of an automatic network analyzer, has allowed more accurate mathematical modeling and prediction of the potentially most susceptible pin-pin firing frequencies of electroexplosive devices. (auth)

7736 (LBL-1125) WAVELENGTH MODULATION SPECTROSCOPY OF SOME SEMICONDUCTORS AND METALS. Stokes, J. A. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 109p. Dep. NTIS $7.50.

Thesis.

7737 (LBL-1403) DIFFUSION AND PHASE RELATIONSHIP STUDIES IN THE ALUMINA-SILICA SYSTEM. Aksay, I. A. (California Univ., Berkeley. Lawrence Berkeley Lab.). Apr 1973. Contract W-7405-eng-48. 125p. Dep. NTIS $8.25.

Thesis.

7738 (LBL-1408) REACTIONS OF HYDROGEN IN LIQUID AMMONIA SYSTEMS. Strom, K. A. (California Univ., Berkeley. Lawrence Berkeley Lab.). Nov 1972. Contract W-7405-eng-48. 50p. Dep. NTIS.

Thesis.

7739 (LBL-1569) ABSOLUTE STANDARD FOR MEASURING COMPUTER SYSTEM PERFORMANCE. Stevens, D. F. (California Univ., Berkeley. Lawrence Berkeley Lab). Jan 1973. Contract W-7405-eng-48. 7p. (CONF-730604-2). Dep. NTIS $3.00.

From National computer conference and exposition; New York, New York, USA (4 Jun 1973).

7740 (LBL-1571) USE OF SYMBOLIC COMPUTER GRAPHICS IN DYNAMIC MODELS OF BIOLOGICAL SYSTEMS. Horovitz, M. W. (California Univ., Berkeley. Lawrence Berkeley Lab). Jan 1973. Contract W-7405-eng-48. 4p. (CONF-730122-1). Dep. NTIS $3.00.

7741 (MHSMP-73-6) REDUCTION OF C-J PRESSURE TEST DATA. Kramer, P. E.; Ashcraft, R. W. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. Development Div.). Dec 1972. 13p. Dep. NTIS $3.00.

An investigation of the models available for Hugoniot Equation (HE) adiabats and their effects on the reduction of Chapman-Jouguet (C-J) pressure test data was conducted. Methods employed, numerical results, and conclusions are presented. (auth)

7742 (MLM-2051) RAPID IDENTIFICATION OF SOME EXPLOSIVES BY THE USE OF SPOT TESTS. Colman, D. M. (Mound Lab., Miamisburg, Ohio). 18 May 1973. Contract At-33-1-GEN-53. 6p. Dep. NTIS $4.00.

Spot tests were developed that permit the rapid identification of some explosives. These tests also allow one to place the explosives in one of three arbitrary classes. (auth)

7743 (NIM-1108) INTERFERENCES RELATING TO THE DETERMINATION OF THE NOBLE METALS BY ATOMIC-ABSORPTION SPECTROPHOTOMETRY. Mallett, R. C.; Pearton, D. C. G.; Ring, E. J.; Steele, T. W. (National Inst. for Metallurgy, Johannesburg (South Africa)). 9 Oct 1970. 24p. Dep. NTIS (U. S. Sales Only) $3.25.

7744 (NIM-1414) USE OF A CLOSED RECIRCULATION APPARATUS IN THE STUDY OF THE GALENA-OXYGEN-XANTHATE SYSTEM. Harris, P. J.; Finkelstein, N. P. (National Inst. for Metallurgy, Johannesburg (South Africa)). 30 Jan 1973. 46p. Dep. NTIS (U. S. Sales Only) $4.50.

7745 (NP-19673) COORDINATION ABILITIES OF SOME HETEROCYCLIC N-BASES AND N-OXIDES TOWARDS VANADYL-BIS(2,4-PENTANEDIONATO) COMPLEXES. Al-Niaimi, N. S.; Al-Karaghouli, A. R.; Aliwi, S. M. (Atomic Energy Commission, Baghdad (IRAQ). Nuclear Research Inst.). Sep 1972. 11p. Dep. NTIS (U. S. Sales Only).

7746 (NP-19726) ANALYSIS OF MOLECULAR FLOW DISTRIBUTION IN HIGH-VACUUM SORPTION STRUCTURES. Preprint A-0167. Gurevich, L. S.; Saksaganskii, G. L. (Scientific Research Inst. of Electro-Physical Apparatus, Leningrad (USSR)). 1972. 19p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

7747 (NRC-TT-1585) REVIEW OF RESEARCH ON THE RELATIONSHIP BETWEEN MECHANICAL PROPERTIES AND CHEMICAL MORPHOLOGICAL STRUCTURE OF THE HYDRATION PRODUCTS OF HYDRAULIC BINDERS. Rio, A.; Saini, A. Translated by D. A. Sinclair (National Research Council of Canada) from Ind. Ital. Cem.; 39: No. 12, 867-874(1969). 19p. Dep. NTIS (U.S. Sales Only) $3.00.

7748 (NRC-TT-1610) PHYLOGENY AND SYSTEMATICS OF BARK BEETLES. Nuesslin, O. Translated by P. F. Bruggemann, H. A. G. Nathan and R. Serre (National Research Council of Canada) from Z. Wiss. Insektenbiol.; 7: No. 1-11, vp(1911). 91p. Dep. NTIS (U. S. Sales Only).

7749 (NRC-TT-1623) MEASUREMENT OF STRAIN IN A MATERIAL BY HOLOGRAPHIC INTERFEROMETRY. Tsujiuchi, J.; Takeya, N.; Matsuda, K. Translated by D. A. Sinclair (National Research Council of Canada) from Opt. Acta; 16: No. 6, 709-722(1969). 20p. Dep. NTIS (U.S. Sales Only) $3.00.

The fringes of the holographic interferometer are studied for different types of movement of the object and the shape and the position of the fringes are obtained. From these studies it is shown that the illuminating beam of the object is parallel to the direction of observation and that the separation of fringes of equal inclination from those of equal thickness allows the measurement of circular displacement and the longitudinal and lateral deformation. (auth)

7750 (NRC-TT-1627) STRUCTURE OF THE INTEGUMENT OF CERTAIN CETACEANS. Sokolov, V. E. Translated by H. R. Hayes (National Research Council of Canada) from Byull. Mosk. Obshch. Ispyt. Prir., Otd. Biol.; 60: No. 6, 45-60(1955). 37p. Dep. NTIS (U. S. Sales Only) $4.00.

7751 (NRC-TT-1629) DIHALOGENO-TRIS-(4-DIMETHYLAMINOPHENYL) COMPOUNDS OF PHOSPHORUS, ARSENIC, ANTIMONY, AND BISMUTH. Keck, J.-M.; Klar, G. Translated by V. N. Nekrassoff (National Research Council of Canada) from Z. Naturforsch.; 27B: 591-595(1972). 10p. Dep. NTIS (U. S. Sales Only) $3.00.

7752 (ORNL-EIS-73-60(Vol.1)(No.1)) NSF-RANN TRACE CONTAMINANTS ABSTRACTS. Copenhaver, E. D. (ed.) (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 38p. Dep. NTIS $4.00.

For National Science Foundation.

7753 (ORNL-EMIC-2) CHEMICAL MUTAGENESIS. A Survey of the 1971 Literature. (Oak Ridge National Lab., Tenn.). Jun 1973. 273p. Dep. NTIS $15.75.

7754 (ORNL-TM-4027) GRAVITY ZERO (Go) ANALYTICAL CLINICAL LABORATORY SYSTEM PROGRESS REPORT FOR THE PERIOD AUGUST 1 TO OCTOBER 31, 1972. Burtis, C. A.; Mailen, J. C.; Johnson, W. F.; Scott, C. D.; Tiffany, T. O.; Watsky, M. B. (Oak Ridge National Lab., Tenn.). Feb 1973. Contract NASA-T-118A. 63p. Dep. NTIS $5.25.

7755 (ORNL-TM-4096) PROPERTIES OF SOLUTION. Water Research Program Biennial Progress Report, March 15, 1966-March 15, 1968. Raridon, R. J.; Moore, G. E. (comps.) (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 89p. Dep. NTIS $6.50.

7756 (ORNL-TM-4112) ELECTROLYTIC DEMONSTRATION UNIT FOR COPPER REMOVAL FROM DISTILLATION PLANT BLOWDOWN. Posey, F. A. (Oak Ridge National Lab., Tenn.). Mar 1973. Contract W-7405-eng-26. 41p. Dep. NTIS $4.25.

7757 (ORNL-TM-4145) REACTIONS AND TRANSPORT PHENOMENA AT SURFACES. Water Research Program Biennial Progress Report, March 15, 1968-November 1, 1970. Posey, F. A.; Moore, G. E. (comps.) (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 149p. Dep. NTIS $9.50.

7758 (ORNL-tr-2568) SPONTANEOUS IGNITION OF CARBON AS A PROCESS PROBLEM CONTRIBUTION TO THE OPERATING SAFETY OF SOLVENT RECOVERY INSTALLATIONS. Bratzler, K. 1972. Translated by R. G. Mansfield (Oak Ridge National Lab., TN), from a German paper. 30p. Dep. NTIS $3.75.

7759 (ORO-3883-4) STUDIES ON THE BIOCHEMISTRY OF DEVELOPMENT IN THE DIPTERA. Final Report. Dobrogosz, W. J. (North Carolina State Univ., Raleigh. Dept. of Microbiology). 27 Feb 1973. 8p. Dep. NTIS $3.00.

7760 (ORO-3941-16) RECOMBINATION IN PNEUMOCOCCUS: REACTANTS AND PRODUCTS. Morrison, D. A.; Guild, W. R. (Duke Univ., Durham, N. C. Dept. of Biochemistry). 1973. 8p. Dep. NTIS $3.00.

7761 (ORO-3982-24) ENZYMATIC SYNTHESIS OF EUKARYOTIC NUCLEIC ACIDS. Progress Report, August 1, 1972-July 31, 1973. Mans, R. J. (Florida Univ., Gainesville). 1973. Contract AT(40-1)-3982. 29p. Dep. NTIS $3.50.

7762 (ORO-4025-2) STUDIES ON THE ROLE OF NERVE IN AMPHIBIAN LIMB REGENERATION. Final Report. Dresden, M.H. (Baylor Univ., Houston, Tex. (USA). Dept. of Biochemistry). Feb 1973. Contract AT(40-1)-4025. 14p. Dep. NTIS $3.00.

7763 (ORO-4056-3) INTRACELLULAR TRANSPORT OF IONS IN MINERALIZING TISSUES. Progress Report, June 1, 1972-February 28, 1973. Matthews, J. L. (Baylor Univ., Dallas, Tex. (USA). Coll. of Dentistry). 1973. Contract AT (40-1)-4056. 5p. Dep. NTIS $3.00.

7764 (ORO-4056-4) INTRACELLULAR TRANSPORT OF IONS IN MINERALIZING TISSUES. Comprehensive Progress Report, June 1970-February 1973. Matthews, J. L. (Baylor Univ., Dallas, Tex. (USA). Coll. of Dentistry). 1973. Contract AT(40-1)-4056. 18p. Dep. NTIS $3.00.

7765 (RHEL/R-244) GFUN USERS' GUIDE: A USER GUIDE TO AN INTERACTIVE GRAPHICS PROGRAM FOR THE COMPUTER AIDED DESIGN OF MAGNETS. Newman, M. J.; Simkin, J.; Trowbridge, C. W.; Turner, L. R. (Rutherford High Energy Lab., Chilton (England)). Sep 1972. 58p. Dep. NTIS (U.S. Sales Only) $5.00. UK 65 pence.

7766 (RISO-M-1589) COHERENT CONCEPT IN CLASSIC AND QUANTUM MECHANICAL INTERPRETATION. Hanson, S. (Danish Atomic Energy Commission, Risoe. Research Establishment). Mar 1973. 20p. (In Danish). Dep. NTIS (U. S. Sales Only) $3.00.

A survey of the coherence properties of thermal light and laser light is given. Temporal, spatial and higher order coherence is treated. The concept is explained from a classical point of view and from a quantum mechanical point of view using Heisenberg's principle of uncertainty. (auth)

7767 (RLO-2221-T-2-14) MUTAGENIC INTERACTION OF SODIUM AZIDE ON MUTATIONS INDUCED IN BARLEY SEEDS TREATED WITH DIETHYL SULFATE OR N-METHYL-N'-NITROSOUREA. Konzak, C. F.; Niknejad, M.; Wickham, I.; Donaldson, E. (Washington State Univ., Pullman. Dept. of Agronomy and Soils). 1973. Contract AT(45-1)-2221. 14p. Dep. NTIS $3.00.

7768 (RLO-2221-T-4-11) FINAL REPORT ON CHEMISTRY, MAY 16, 1967-SEPTEMBER 1, 1972. Hunt, J. P. (Washington State Univ., Pullman. Dept. of Chemistry). 1972. Contract AT(45-1)-2221. 5p. Dep. NTIS.

Results from NMR studies designed to provide information on the nature (description) of metal ion species, equilibrium relations among species, and the kinetic behavior of the metal complexes are discussed very briefly. A listing of 19 publications resulting from work under the contract is included. (LMT)

7769 (RLO-2225-5-15) PROBABILITY OF FIXATION OF A MUTANT WHEN SELECTION COEFFICIENTS VARY RANDOMLY WITH TIME. Felsenstein, J. (Washington Univ., Seattle. Dept. of Genetics). 1973. Contract AT(45-1)-2225. 18p. Dep. NTIS $3.00.

7770 (RLO-2226-T-1-11) STUDIES OF GENETIC ALTERATIONS OF HUMAN CELLS AND MOLECULES AND THE

FACTORS INFLUENCING THEM. Progress Report, August 1, 1972-April 30, 1973. (Oregon Univ., Portland. Medical School). [nd]. Contract AT(45-1)-2226. 6p. Dep. NTIS $3.00.

7771 (RLO-2227-T-9-9) MINERALOGY AND TRACE ELEMENT CHEMISTRY OF MAZAMA ASH SOILS. Dudas, M. J. (Oregon State Univ., Corvallis). Jun 1973. 134p. Dep. NTIS $8.75.

7772 (RLO-2227-T-9-10) GENESIS, MINERALOGY, AND PROPERTIES OF PARKDALE SOILS, OREGON. Harris, B. L. (Oregon State Univ., Corvallis). Jun 1973. Contract AT(45-1)-2227-T9. 187p. Dep. NTIS $11.50.

Thesis.

7773 (RLO-2229-T-1-19) WORK IN PROGRESS [TRACE METAL ASSOCIATIONS IN SUBARCTIC FJORD ENVIRONMENTS]. Burrell, D. C. (Alaska Univ., College. Inst. of Marine Science). [nd]. Contract AT(45-1)-2229. 7p. Dep. NTIS $3.00.

7774 (RT/BIO-(72)17) DURUM WHEAT MUTANTS IN PERFORMANCE FIELDS OF MARCHE. Mosconi, C. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 16 Sep 1970. 16p. (In Italian). (CONF-700458-1). Dep. NTIS (U. S. Sales Only) $3.00.

From 14th conference of Italian Agricultural Genetics Society; Parma, Italy (1 Apr 1970).

7775 (SAN-779-3) FACILITATION OF TRANSPLANTATION BY SERUM FACTORS. Progress Report, October 1, 1972–March 31, 1973. Feldman, J. D. (Scripps Clinic and Research Foundation, La Jolla, Calif. Dept. of Experimental Pathology). 1973. Contract AT(04-3)-779. 8p. Dep. NTIS $3.00.

7776 (SC-DC-721743) SIMPLIFIED DYNAMIC MODEL OF PARACHUTE INFLATION. Wolf, D. (Sandia Labs., Albuquerque, N. Mex.). 1973. 16p. (CONF-730523-1). Dep. NTIS $3.00.

From aerodynamic deceleration systems conference; Palm Springs, California, USA (21 May 1973).

The model predicts increased dimensionless inflation times and increased dimensionless inflation forces observed at high altitudes. As altitude is increased, greater relative parachute inertia results in increased inflation times, and greater relative forebody inertia results in increased maximum inflation forces. Upper limit effects of Mach number on inflation time and force are also predicted by the inflation model. (auth)

7777 (SC-RR–72-449) VISCOUS SHOCK-LAYER FLOW IN THE WINDWARD PLANE OF CONES AT ANGLE OF ATTACK. Eaton, R. R.; Kaestner, P. C. (Sandia Labs., Albuquerque, NM). Mar 1972. 66p. Dep. NTIS $3.00.

A method is developed for solving the thin viscous shock-layer equations for flow along the windward meridional plane of sharp cones at angle of attack. The shock-layer equations are obtained from the Navier–Stokes equations by retaining terms up to second-order in the inverse square root of the Reynolds number. The resulting parabolic equations are solved using a Crank–Nicolson type numerical scheme. Results are presented for 10 and 15° half-angle cones, at angles of attack up to 10°, and for Mach numbers from 10 to 20. Comparisons of numerical results with experimental data corroborate the validity of this approach. (auth)

7778 (SC-RR–72-826) INVESTIGATION OF THE RELATION BETWEEN THE TURBULENT ENERGY SPECTRUM AND THE ENERGY TRANSFER FUNCTION FOR ISOTROPIC FLUIDS. Fox, R. L. (Sandia Labs., Albuquerque, NM). Mar 1972. 21p. Dep. NTIS $3.00.

The nature of the interaction between turbulent eddies is investigated by combining solutions for the three-dimensional turbulent energy spectrum and the energy-transfer function obtained for homogeneous isotropic fluids with phenomenological theories. (auth)

7779 (SCL-DC-720375) CENTERLINE VELOCITY DECAY OF COMPRESSIBLE FREE JETS USING A NEW CORRELATION FOR THE EDDY VISCOSITY. Witze, P. O. (Sandia Labs., Livermore, Calif.). Apr 1973. Contract AT(29-1)-789. 38p. Dep. NTIS $4.00.

A new formulation for the eddy viscosity is introduced into the turbulent axially symmetric compressible free jet theory of Kleinstein. The analysis gives excellent agreement with an extensive compilation of experimental data for the centerline velocity decay in the main region. It is shown that the eddy viscosity can be treated as constant, with functional dependence on only the exit Mach number and the jet-to-freestream density ratio. The theory presented is applicable to the main region of most classes of free jets, including heterogeneous, nonisothermal, and subsonic and properly expanded supersonic flows. (auth)

7780 (SGAE-2102) HYPOXANTHINE-QUANINE PHOSPHORIBOSYLTRANSFERASE ACTIVITIES IN SOME PATIENTS WITH GOUT AND HYPERURICEMIA. Partsch, G.; Frank, O.; Altmann, H. (Oesterreichische Studiengesellschaft fuer Atomenergie, Seibersdorf. Institut fuer Biologie). Feb 1973. 9p. Dep. NTIS (U. S. Sales Only) $3.00.

7781 (SGAE-2108) INHIBITION OF XANTHINE OXIDASE BY ADDITIVES USED IN PHARMACEUTICAL INDUSTRY. Partsch, G.; Altmann, H. (Oesterreichische Studiengesellschaft fuer Atomenergie, Seibersdorf. Institut fuer Biologie). Mar 1973. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

7782 (SLA-73-126) SAMMSOR III: A FINITE-ELEMENT PROGRAM TO DETERMINE STIFFNESS AND MASS MATRICES OF RING-STIFFENED SHELLS OF REVOLUTION. Haisler, W. E.; Stricklin, J. A.; Von Riesemann, W. A. (Texas Agricultural and Mechanical Univ., College Station). 1 Dec 1972. 96p. (TEES-72-26). Dep. NTIS $3.00.

A user's guide for the SAMMSOR III (Stiffness And Mass Matrices for Ring-Stiffened Shells Of Revolution) computer code is presented. The finite-element method analysis is employed using curved shell of revolution elements and/or curved beam elements to determine structural stiffness and mass matrices. The SAMMSOR III program prepares an output tape containing stiffness and mass properties which is then used as input to the DYNAPLAS code wherein the dynamic equations are solved. Documentation of the analysis technique is included along with user guidelines and a discussion of the program limitations. Instructions for preparing the SAMMSOR input data are given along with several example problems which demonstrate the required input data. SAMMSOR III has the capability of internally generating the geometry of a number of important classes of shell configurations (such as shallow caps, cylinders, cones, hemispheres, etc.). Results of several example problems are presented to aid the user in check-out and for comparison purposes. An Appendix is included which provides the interested user with flow charts, variable names, subroutine functions, etc. (auth)

7783 (SLA-73-211) SHOCK AND RELEASE BEHAVIOR IN POROUS 1100 ALUMINUM. Asay, J. R. (Sandia Labs., Albuquerque, N. Mex.). Apr 1973. 52p. Dep. NTIS $4.75.

7784 (SLA-73-342) STATISTICAL FAILURE CHARACTERISTICS AND A PROBABILISTIC EVALUATION OF THE STATIC STRENGTH OF STRUCTURAL COMPONENTS MADE OF COMPOSITE POLYMER MATERIALS. Serensen, S. V.; Strelyaev, V. S. Translated from Mekh. Polim.; 8: No. 3, 466-482(1972). 35p. (CONF-711150-1). Dep. NTIS $3.75.

From 2nd all-union conference on polymer mechanics; Riga, USSR (10 Nov 1971).

7785 (SLA-73-362) ERROR ANALYSIS OF A BELL-TYPE PROVER FOR USE AS A GAS FLOW RATE STANDARD. Hartley, J. L. (Sandia Labs., Albuquerque, N. Mex.). Mar 1973. 57p. Dep. NTIS $5.00.

An error analysis was performed on an American Meter Company Model 15L Gas Prover. It was found that gas flow rates from 0.5 to 30 cubic feet per minute can be measured with an estimated systematic error (bias) of 0.18%, and with a random deviation estimated to be no greater than 0.06%. (auth)

7786 (SLA-73-366) THREE-DIMENSIONAL, INCOMPRESSIBLE BOUNDARY LAYER ON BLUNT BODIES. Part I. Analysis and Results. Blottner, F. G.; Ellis, M. (Sandia Labs., Albuquerque, N. Mex.). Apr 1973. 99p. Dep. NTIS $7.00.

The governing equations for laminar flow in terms of an orthogonal surface coordinate system on blunt bodies are solved numerically. The coordinate system is determined by the intersection with the body surface of meridional planes which pass through an axis containing the stagnation point. The other coordinate is obtained numerically from the orthogonality condition. The inviscid flow is obtained from the potential flow for triaxial ellipsoids and elliptic paraboloids at incidence. The governing equations are transformed with new independent and dependent variables of the Goertler type. The particulars of the finite-difference solutions of these equations with Crank-Nicolson and Krause schemes are presented. Details of the flow in a region on an ellipsoid at high incidence is given where the results indicate a vortex is being formed. Solutions are obtained for the flow over a paraboloid and elliptic-paraboloid with and without incidence and the distribution of skin friction over these bodies is given. (auth)

7787 (SLA-73-507) CONTRIBUTION TO THE PROBABILITY ANALYSIS OF THE NUCLEATION PROCESS. Part 2.

Toshev, S.; Milchev, A. Translated from Izv. Otd. Khim. Nauki, Bulg. Akad. Nauk.; 3: No. 4, 755-774(1970). 755-774p. Dep. NTIS $3.75.

7788 (SLA-73-519) TERRAIN RECOGNITION COMPUTER SIMULATION. Cooper, J. A.; Melick, L. M. (Sandia Labs., Albuquerque, N. Mex.). May 1973. 20p. Dep. NTIS $3.00.

A computer model is developed that allows simulation of many of the terrain characteristics that give structure to radar return pulses, such as ground contours and reflectivity variations. The model and flight simulations are presented in order to demonstrate the kind of information that can be obtained and the kind of position indications theoretically available from correlation computations. (auth)

7789 (SLA-73-604) DISTRIBUTION OF RAINDROPS ACCORDING TO SIZE. Mazin, I. P.; Nevzorov, A. N. Translated by Patricia Newman (Sandia Labs., Albuquerque, N. Mex.) from Meteorol. Gidrol.; No. 4, 99-106(1968). 17p. Dep. NTIS $3.00.

Experimental data are presented on the concentrations and size distributions of raindrops in continuous rain and in shower rain obtained with the aid of an aircraft photoelectric instrument. The total volume of precipitation studied during the period 1962–66 exceeded 1500 m^3. The data obtained indicate the existence of relationships between the size spectra of the drops and the type and intensity of precipitation. (auth)

7790 (SLA-73-5066) THIN-FILM METALLIZATION OF OXIDES IN MICROELECTRONICS. Mattox, D. M. (Sandia Labs., Albuquerque, N. Mex.). 1972. 25p. (CONF-730608-1). Dep. NTIS $3.25.

From 27th annual frequency control symposium; Atlantic City, New Jersey, USA (12 Jun 1973).

The various factors important to adhesion in the thin-film metallization of oxides are reviewed. These include nucleation, interface formation, film properties, surface effects, bonding, and stability. Specific metallization systems in common use in microelectronics are discussed. (100 references) (auth)

7791 (SLA-73-5280) COUPLING OF HIGH-FREQUENCY ELECTROMAGNETIC ENERGY INTO LARGE SYSTEMS. Varnado, G. B. (Sandia Labs., Albuquerque, N. Mex.). 1972. 16p. (CONF-730615-2). Dep. NTIS $3.00.

From international symposium on electromagnetic compatibility; New York, New York, USA (20 Jun 1973).

Aircraft and missile systems contain many components that can be damaged by exposure to electromagnetic environments. The increasing use of high-power radar systems in the vicinity of air fields and missile farms has caused concern that the safety and reliability of aerospace systems may be degraded as a result of their exposure to fields produced by the radars. A program is currently underway to develop techniques for analyzing the response of aerospace systems to electromagnetic environments at frequencies above 100 MHz. The initial results of that program are discussed. (MOW)

7792 (SLA-73-5335) WATER ENTRY CAVITY-PRESSURE MEASUREMENTS. Doak, D. W.; Ferguson, G. M. (Sandia Labs., Albuquerque, N. Mex.). 1970. 6p. (CONF-730607-1). Dep. NTIS $3.00.

From joint meeting on fluids engineering and applied mechanics divisions; Atlanta, Georgia, USA (20 Jun 1973).

Techniques of pressure measurement for instrumented projectiles dropped from aircraft and entering water at 230 to 975 ft/sec are briefly described, and some tabular data are given. (LMT)

7793 (SLA-73-5375) DYNAMIC YIELD STRENGTH DETERMINATION AT ELEVATED TEMPERATURES AFTER NANOSECOND PULSE HEATING. Lipkin, J. (Sandia Labs., Albuquerque, N. Mex.). 1972. 31p. (CONF-730511-3). Dep. NTIS $3.75.

From 3rd international congress on experimental mechanics conference; Los Angeles, California, USA (14 May 1973).

An experimental method is described that has been used to determine the yield strength of 6061-T6 aluminum after extremely short times at elevated temperature. The method combines electron beam pulse heating and one-dimensional stress wave loading. (JCW)

7794 (SLA–73-5388) PROPOSED ELECTROSTATIC SENSITIVITY DEVELOPMENT TESTER. Weems, D. T. (Sandia Labs., Albuquerque, N. Mex.). 8 Mar 1973. 10p. (CONF-730504–1). Dep. NTIS $3.00.

From evaluation of electrostatic hazards of explosives conference; Dover, New Jersey, USA (24 May 1973).

7795 (SLAC-Trans-136) INFLUENCE OF CERTAIN PARAMETERS OF A PENNING PUMP ON ITS STABILITY IN ARGON. Vaumoron, J. Translated from Vide; 25: No. 145, 26-32(1970). 18p. Dep. NTIS $3.00.

Observation of the slotted cathodes of a Penning pump after several hours of operation at various pressures permits the minimum angle of incidence of the ions on the cathode surface to be measured. The variations of the angle of incidence with pressure provide an explanation of the phenomenon on instability in argon. The stability criteria are applicable to various types of pumps. A stable pump constructed on the basis of these criteria is described by way of illustration. (auth)

7796 (STI/PUB-300(Vol.15)) PEACEFUL USES OF ATOMIC ENERGY. Proceedings Series. Proceedings of the Fourth International Conference Held in Geneva, Switzerland, September 6–16, 1971. (International Atomic Energy Agency, Vienna (Austria)). Dec 1972. 185p. (CONF-710901-(Vol.15)). IAEA $14.00.

From 4th international conference on the peaceful uses of atomic energy; Geneva, Switzerland (6 Sep 1971).

A subject index is presented for the fourteen volumes containing the 514 papers presented at the Fourth International Conference on the Peaceful Uses of Atomic Energy. Included are a subject index, an author index, a paper number index, a complete Contents List of all volumes, and a List of Delegates. (FS)

7797 (TID-26304) VACUUM UV PHOTOLYSES OF PROPYLENE OXIDE AND OXETANE. Hsi, H. T. (Worcester Polytechnic Inst., Mass.). Oct 1972. 33p. Dep. NTIS $3.75. Thesis.

7798 (TID-26327) ELECTRONIC SPECTROSCOPY OF HIGHLY POLAR AROMATICS. Khalil, O. S. (Louisiana State Univ., Baton Rouge). Dec 1972. 125p. Dep. NTIS $8.25. Thesis.

The class of organic molecules that exhibits a relatively large ground-state dipole moment is of immense proportions. In this dissertation a rather narrow segment of this large class (namely, molecules designated by the structure D–Ar–A, where D is an electron donor group, Ar is an unsaturated ring system, and A is an electron acceptor group) is discussed. The author believes that these molecules are prototypical of the remaining members of the class of "highly polar aromatics". (21 references) (auth)

7799 (TID-26328) EXCITED-STATE PROPERTIES OF AMIDE-CONTAINING MOLECULES. Larson, D. B. (Louisiana State Univ., Baton Rouge). Aug 1972. 413p. Dep. NTIS $22.75. Thesis.

The following proposition was investigated and found to be both reasonable and useful: the excited-state properties of amide-containing molecules may be rationalized by a consideration of the excited-state properties of the isolated group and other appropriate functional units. Detailed correlations of the MO's and states resulting from CNDO/s calculations indicate that even molecules as complex as parabanic acid may be successfully analyzed in terms of the MO's and states of its component parts. The experimental excited state properties of direct-interaction amides may also be correlated successfully with those of appropriate isolated amides. In addition, the correlations of experimental and theoretical results compare favorably. (46 tables, 71 figures, 200 references) (JGB)

7800 (TID-26330) PHYSICO-CHEMICAL STUDY OF SOME AREAS OF FUNDAMENTAL SIGNIFICANCE TO BIOPHYSICS. Annual Report, 1972–1973. McGlynn, S. P. (Louisiana State Univ., Baton Rouge. Dept. of Chemistry). 15 May 1973. Contract AT(40-1)-3018. 43p. Dep. NTIS $4.25.

7801 (UCID-15623(Rev.1)) ANALYSIS OF PLASTIC-BONDED EXPLOSIVES CONTAINING HMX, AMMONIUM PERCHLORATE, ALUMINUM, AND VITON. Selig, W.; Crossman, G. L. (California Univ., Livermore. Lawrence Radiation Lab.). 14 Jun 1971. Contract W-7405-eng-48. 6p. Dep. NTIS $3.00.

7802 (UCID-16189) JWL EQUATION OF STATE COEFFICIENTS FOR HIGH EXPLOSIVES. Lee, E.; Finger, M.; Collins, W. (California Univ., Livermore. Lawrence Livermore Lab.). 16 Jan 1973. Contract W-7405-eng-48. 8p. Dep. NTIS $3.00.

7803 (UCID-16216) STREAK CAMERA TUBE FOR THE PERIOD OF MARCH 1, 1972 TO JULY 31, 1972. Kalibjian, R. (California Univ., Livermore. Lawrence Livermore Lab.). 8 Aug 1972. 16p. Dep. NTIS $3.00.

7804 (UCID-16241) DETERMINATION OF GOLD IN ELECTROPLATING SOLUTIONS BY CONTROLLED-POTENTIAL COULOMETRY. Harrar, J. E.; Waggoner, M. C. (California

Univ., Livermore. Lawrence Livermore Lab.). 2 Apr 1973. Contract W-7405-eng-48. 11p. Dep. NTIS $3.00.

7805 (UCLA-34-P-102-44) ISOTOPIC STUDIES ON STRUCTURE–FUNCTION RELATIONSHIPS OF NUCLEIC ACIDS AND ENZYMES. Progress Report for the Period May 1, 1972–April 30, 1973. Boyer, P. D. (California Univ., Los Angeles). [nd]. Contract AT(04-3)-34.. 8p. Dep. NTIS $3.00.

7806 (UCLA-34-P-172-7) PARTICLE-SIZE-DISTRIBUTION EFFECTS IN PRECIPITATION HARDENING. Third Annual Progress Report for the Contract Period February 1, 1971–December 31, 1971. Ardell, A. J. (California Univ., Los Angeles. Dept. of Materials). Jan 1972. Contract AT(04-3)-34. 37p. (UCLA-ENG-7214). Dep. NTIS.

Progress is reported on the following three research projects: (1) coarsening of γ' at high volume fractions in aged Ni–Cr–Al alloys; (2) bimodal distributions of γ' precipitates in Ni–8 wt.% Al alloys; and (3) sinusoidal aging of γ/γ' alloys (studied with Ni–7 wt.% Al alloys). (LMT)

7807 (UCRL-51367) SHOCK WAVE HUGONIOT AND ELECTRICAL CONDUCTIVITY OF LIQUID AMMONIA IN THE PRESSURE RANGE 45 kb TO 282 kb. Kovel, M. I. (California Univ., Livermore. Lawrence Livermore Lab.). 22 Mar 1973. Contract W-7405-eng-48. 94p. Dep. NTIS $5.45.

Thesis.

The P–V–T behavior and electrical conductivity of liquid NH_3 were investigated by shock wave techniques, in the pressure range 45 kb to 282 kb and the temperature range 600°K to 2300°K. A theoretical equation of state was fitted to the Hugoniot data, using an effective pair potential of the form $\phi(r) = \epsilon[(6/\alpha-6)] \exp \{\alpha[1 - (r/r^*) - (\alpha/\alpha - 6)(r/r^*)^6\}]$, with the parameters $\epsilon/k = 150°K$, $r^* = 3.88$ A°, $\alpha = 12.5$. The conductivity was found to vary exponentially with both temperature and density, reaching a value of 1.55 Ω^{-1} cm^{-1} at 282.5 kb and 2236°K. (MOW)

7808 (UCRL-74324) HIGH-SECURITY DIGITAL ALARM SYSTEM. West, D. G. (California Univ., Livermore. Lawrence Livermore Lab.). 19 Feb 1973. 12p. (CONF-730421-1). Dep. NTIS $3.00.

From Carnahan Conference on Electronic Crime Countermeasures; Lexington, Kentucky, USA (25 Apr 1973).

A prototype alarm system designed to provide security for approximately 100 remote protected areas is described. The system monitors the changes in the status of the telephone lines and the remote alarm sensors of each protected area. The unit in the protected area uses low power electronics (MOS) to generate a nonlinear pseudo-random number every ½ second (it would take many years to determine this number without the use of a large scale computer). This number, together with the status of the alarm sensor, is transmitted over a standard pair of leased telephone lines to the central station. Power is supplied to the protected area over the same telephone lines. (MOW)

7809 (UCRL-74396) STRESS–RUPTURE OF STRANDS OF AN ORGANIC FIBER/EPOXY MATRIX. Chiao, T. T.; Wells, J. E.; Moore, R. L.; Hamstad, M. A. (California Univ., Livermore. Lawrence Livermore Lab.). 1 Mar 1973. 36p. (CONF-730331-1). Dep. NTIS $4.25.

7810 (UCRL-74573) SMOKE HAZARDS AND THEIR MEASUREMENT. A Researcher's Viewpoint. Gaskill, J. R. (California Univ., Livermore. Lawrence Livermore Lab.). 8 Mar 1973. 20p. (CONF-730329-1). Dep. NTIS $3.00.

From Armstrong symposium; Lancaster, Pennsylvania, USA (25 Mar 1973).

7811 (UCRL-74577) PREDICTIVE MODEL BASED ON THE RELATIONSHIP BETWEEN METEOROLOGICAL AND EMISSION PATTERNS AND AIR QUALITY. Pollack, R. I. (California Univ., Livermore. Lawrence Livermore Lab.). 22 Feb 1973. 5p. (CONF-730610-2). Dep. NTIS $3.00.

From 3rd conference on probability and statistics in atmospheric science; Boulder, Colorado, USA (19 Jun 1973).

7812 (UCRL-74616) MONTHLY MEAN VALUES OF EDDY DIFFUSION COEFFICIENTS IN THE LOWER STRATOSPHERE. Luther, F. M. (California Univ., Livermore. Lawrence Livermore Lab.). 4 Apr 1973. 11p. (CONF-730614-2). Dep. NTIS $3.00.

From conference on environmental impact of aerospace operations in the high atmosphere; Denver, Colorado, USA (11 Jun 1973).

The mixing length hypothesis is used to compute monthly mean values of large-scale meridional diffusion coefficients at each 5° of latitude from 10°S through 75°N and for 200, 100 and 50 mb. The coefficients are computed from the transport of sensible heat, and the meridional diffusion coefficient is assumed proportional to the variance of the meridional wind speed. The values of the meridional and anisotropic diffusion coefficients generally lie between seasonal values reported by others. The values of the vertical diffusion coefficient below 50 mb are somewhat smaller, particularly in middle latitudes. The difference from earlier results is attributed to the data used. (auth)

7813 (UCRL-74672) REDUCTION OF MACHINE TOOL SPINDLE GROWTH. Bryan, J. B.; Donaldson, R. R.; Clouser, R. W.; Blewett, W. H. (California Univ., Livermore. Lawrence Livermore Lab.). 29 Mar 1973. (CONF-730520-1; CONF-730617-1). Dep. NTIS $3.25.

From North American Metalworking Research Conference; Hamilton, Ontario, Canada (14 May 1973).

A method is described for reducing machine tool spindle growth by forcing a large flow of temperature-controlled oil directly through the rolling-element bearings of the spindle. Experimental results show approximately a five-fold reduction in both spindle growth and warmup time for temperature-control systems retrofitted to two makes of lathes. (auth)

7814 (UCRL-74679) DISPERSION OF EXHAUST PLUMES IN THE STRATOSPHERE. Walton, J. J. (California Univ., Livermore. Lawrence Livermore Lab). 2 Apr 1973. 7p. (CONF-730614-3). Dep. NTIS $3.00.

From conference on environmental impact of aerospace operations in the high atmosphere; Denver, Colorado, USA (11 Jun 1973).

Because of the continued passage of aircraft over specific areas of the earth, local regions of high concentration may be expected to appear and be sustained. This problem is enhanced since early time dispersion occurs at a slower rate than predicted using global-scale diffusion coefficients. For this reason, using the superposition of nonreactive plumes being dispersed by scale-dependent diffusion, the characteristic concentration growth curves and profiles of such a flight corridor have been obtained. A linear relation was found between maximum concentration and flight frequency while only a weak dependence on corridor dimension was observed. As a specific example, a flight corridor 400 km in the horizontal by 3 km in the vertical with a flight frequency of 180 round trips per day was considered. Maximum corridor concentration rose to approximately 10% of that of a single plume at the end of the wake-dispersion regime with concentrations dropping to 1/e of this maximum in 1800 km and 2.8 km in the horizontal and vertical respectively. (auth)

7815 (UCRL-Trans-1495) CONTRIBUTIONS TO THE KNOWLEDGE OF THE CURRENT DISTRIBUTION IN POROUS ELECTRODES. Winsel, A. Translated from Z. Elektrochem.; 66: 287-304(1962). 75p. Dep. NTIS $5.75.

The current distribution in the ideal circular–cylindrical pore of a porous electrode is described by an integral equation that is valid for arbitrary functions of the electrode–electrolyte interfacial resistance. This study arose in the frame of a project whose goal was the development of an efficient hydrogen–oxygen fuel cell. (LMT)

7816 (UCRL-Trans-1497) HOW QUANTUM EFFECTS OF THE METHYL-GROUP ROTATION AFFECT THE NUCLEAR RELAXATION IN SOLIDS. Haupt, J. Translated from Z. Naturforsch., a; 26a: 1578-1589(1971). 32p. Dep. NTIS $3.75.

7817 (UCRL-Trans–10654) CALCULATION OF THE CRACK LENGTH VARIATION WITH THE BOREHOLE DIAMETER FOR A CONSTANT QUANTITY OF EXPLOSIVE PER METER. Ouchterlony, F. Translated from Conference on Rock Mechanics, 12 February 1971, Stockholm, Sweden. (CONF-710228–1). 21p. Dep. NTIS $3.25.

From conference on rock mechanics; Stockholm, Sweden (12 Feb 1971).

In order to be able to optimize blasting operations from the viewpoint of economics as well as safety, a thorough knowledge of the blasting process is required. The present contribution was aimed at a clarification of the crack propagation phase. (auth)

7818 (UCRL-Trans-10685) NUMERICAL REALIZATION OF BOUNDARY CONDITIONS IN PROBLEMS IN ELASTICITY THEORY. Almukhanbetov, N. Translated from Chislennye Metody Mekh. Sploshnoi Sredy; 3: No. 5, 3-16(1972). 20p. Dep. NTIS $3.00.

7819 (UCRL-Trans-10687) BIOCYBERNETICS OF MAN. Keidel, W. D. Translated from Aerztl. Forsch.; 26: No. 3, 73-86(1972). 33p. Dep. NTIS $3.75.

7820 (UR-3490-97) CALCIUM TRANSPORT IN THE SMALL INTESTINE. Warner, R. R.; Coleman, J. R. (Rochester Univ.,

N. Y. (USA). Dept. of Biophysics). 1972. Contract AT(11-1)-3490. 4p. (CONF-720714-3). Dep. NTIS $3.00.

From 7th national conference on electron probe analysis; San Francisco, California, USA (17 Jul 1972).

7821 (UR-3490-98) COMPUTER PROGRAM FOR QUANTITATIVE MICROANALYSIS OF THIN BIOLOGICAL MATERIAL. Warner, R. R.; Coleman, J. R. (Rochester Univ., N. Y. (USA). Dept. of Biophysics). 1972. Contract AT(11-1)-3490. 5p. (CONF-720714-4). Dep. NTIS $3.00.

From 7th national conference on electron probe analysis; San Francisco, California, USA (17 Jul 1972).

7822 (UR-3490-100) ELEMENTAL ANALYSIS OF REFRACTILE BODIES IN AMOEBA PROTEUS. Coleman, J. R.; Warner, R. R.; Nilsson, J. R. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics; Carlsberg Foundation, Copenhagen (Denmark). Biological Inst.). 1971. 5p. (CONF-720714-5). Dep. NTIS $3.00.

From 7th national conference on electron probe analysis; San Francisco, California, USA (17 Jul 1972).

7823 (UR-3490-207) TECHNIQUE OF ISOLATED RAT LIVER PERFUSION DEVELOPED AT THE UNIVERSITY OF ROCHESTER, SCHOOL OF MEDICINE AND DENTISTRY. Miller, L. L. (Rochester Univ., N. Y. School of Medicine and Dentistry). 1972. 65p. (CONF-710739-1). Dep. NTIS $5.25.

From 1st European Meeting on Technique of Perfusion of Isolated Liver and Its Application; Milan, Italy (Jul 1971).

7824 (UR-3490-243) COMPARATIVE ASPECTS OF RADIOFREQUENCY AND MICROWAVE BIOMEDICAL RESEARCH. Preliminary Summary. Michaelson, S. M.; Schwan, H. P. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1971. 10p. (CONF-730609-1). Dep. NTIS $3.00.

From international microwave symposium; Boulder, Colorado, USA (4 Jun 1973).

7825 (UR-3490-271) RATES OF EARLY EFFECTS OF GLUCOCORTICOIDS ON RAT THYMUS CELLS IN VITRO: A RATE HYPOTHESIS OF HORMONE-RECEPTOR COMPLEX ACTION. Hallahan, C.; Young, D. A.; Munck, A. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1972. 10p. (CONF-720633-3). Dep. NTIS $3.00.

From 4th international congress of endocrinology; Washington, District of Columbia, USA (19 Jun 1972).

7826 (US-IBP-72-3(Vol.2)(No.4)) ABSTRACTS US INTERNATIONAL BIOLOGICAL PROGRAM ECOSYSTEM ANALYSIS STUDIES. Ferguson, N. (ed.) (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 73p. Dep. NTIS $5.75.

7827 (US-IBP-73-1(Vol.3)(No.1)) ABSTRACTS US INTERNATIONAL BIOLOGICAL PROGRAM ECOSYSTEM ANALYSIS STUDIES. Ferguson, N. (ed.) (Oak Ridge National Lab., Tenn.). Mar 1973. Contract W-7405-eng-26. 61p. Dep. NTIS $5.25.

7828 (Y-1873) EXPLOSIBILITY TEST FACILITY FOR POWDERS. Lore, J. D.; Miller, J. E. (Oak Ridge Y-12 Plant, TN (USA)). 4 May 1973. Contract W-7405-eng-26. 30p. Dep. NTIS $3.00.

A laboratory test facility was developed for assessing the ignitability and explosibility of powder disseminations. The occurrences of frequently unforeseen powder fires and explosions during production operations and in the course of laboratory handling, prompted its development. General guidelines regarding the equipping of the facility were obtained from the United States Bureau of Mines. Typical application of the facility to powdered aluminum and magnesium was investigated. (auth)

7829 (Y-DJ-8055(Rev.1)) APPRECIATION OF BAYESIAN TOLERANCE LIMITS FOR CHEMICAL IMPURITIES. Telford, J. L. (Oak Ridge Y-12 Plant, Tenn. (USA)). 1970. Contract W-7405-eng-26. 7p. (CONF-730506-1). Dep. NTIS $3.00.

From annual technical conference; Cleveland, Ohio, USA (21 May 1973).

7830 (TP-388) GREEN FUNCTION METHOD FOR THE CALCULATION OF DISTORTION AROUND A POINT DEFECT IN A CRYSTAL LATTICE. Tewary, V. K. (Atomic Energy Research Establishment, Harwell (England)). Dec 1969. 71p. Dep. NTIS (U. S. Sales Only) $5.75.

A Green function method, based on the Born von Karman model for a lattice, is described for the calculation of distortion produced by a point defect in a crystal lattice. The method uses the zero frequency limit of the phonon Green function that gives the static response of the lattice to an applied force. This method is shown to be formally equivalent to the Kanzaki method but appears to be more powerful and computationally more convenient. The Green function method is illustrated by applying it to calculate the displacement field due to a substitutional defect or a vacancy in sc, bcc, and fcc lattices and body centered and split dumb-bell interstitials in an fcc lattice. Numerical results are given for these defects in copper. An expression for the total interaction energy between two similar point defects has also been derived in terms of the Green function. (auth)

7831 (ZJE-135) METHODS OF DETERMINING TRIAXIAL INITIAL STRESSES IN WELDS. Kupka, I. (Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Construction Dept.). 1972. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

The method of measurement of triaxial residual stresses within the interior of a body is described and its accuracy is determined. Investigations have shown that residual stress is only one of the factors causing the brittle crack initiation; other factors contributing are the existence of stress concentrator, low notch toughness, and low temperature. Examples show the distribution of residual stresses in welds. (JCW)

7832 ROLAMITE SENSORS (26 OCT. 1971) (ENGINEERING MATERIALS). (Bendix Corp., Kansas City, MO). (Cape-2332). 9 drawings.

7833 POSITIONING-ERROR MEASURING SYSTEM FOR NUMERICALLY CONTROLLED MACHINES (ENGINEERING MATERIALS). (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). (CAPE-2336). 10 drawings.

7834 LLL DRY HOLE ACOUSTIC LOG (19 JAN 1973) (ENGINEERING MATERIALS). (California Univ., Livermore. Lawrence Livermore Lab.). (CAPE-2334). 74 drawings.

COLLECTIONS OF USAEC REPORTS IN COUNTRIES OTHER THAN THE UNITED STATES

ARGENTINA
Buenos Aires, Comisión Nacional de Energía Atomica

AUSTRALIA
Canberra, National Library of Australia
Sutherland, New South Wales Atomic Energy Research Establishment

AUSTRIA
Vienna, Zentralbibliothek der Physikalischen Institute der Universität

BELGIUM
Mol-Donk, Centre d'Etude de l'Energie Nucléaire

BRAZIL
Rio de Janeiro, Comissão Nacional de Energia Nuclear
São Paulo, Instituto de Energia Atomica

CANADA
Chalk River, Ontario, Atomic Energy of Canada, Ltd., Chalk River
Ontario, McMaster University
Ottawa, National Research Council
Vancouver, B.C., University of British Columbia Library

DENMARK
Risö, Danish Atomic Energy Commission

FINLAND
Otaniemi, Teknillinen Korkeakoulu

FRANCE
Saclay, Gif-sur-Yvette, Centre d'Etudes Nucléaires de Saclay

GERMANY, WEST
Leopoldshafen, Zentralstelle für Atomkernenergie Dokumentation
Munchen, Technischen Universitat

GREECE
Athens, Nuclear Research Center, Democritus Library

INDIA
Bombay, Trombay, Bhabha Atomic Research Center Library

IRAQ, REPUBLIC OF
Baghdad, Atomic Energy Commission, Nuclear Research Instituto

IRELAND
Dublin, University College

ISRAEL
Yavne, Israel Atomic Energy Commission, Soreq Nuclear Research Centre

ITALY
Rome, Centro di Studi Nucleari della Casaccia

JAPAN
Tokyo, National Diet Library
Tokai-Mura, Naka-gun, Ibaraki-ken, Japan Atomic Energy Research Institute

KOREA, REPUBLIC OF
Seoul, Atomic Energy Research Institute

MEXICO
Mexico, D. F., Comisión Nacional de Energía Nuclear

NETHERLANDS, THE
Petten, Holland, Reactor Centrum Nederland
The Hague, Bibliothek Octrooiraad

NORWAY
Kjeller, Institutt for Atomenergi

PERU
Lima, Junta de Control de Energia Atómica

PORTUGAL
Sacavem, Junta de Energia Nuclear

SOUTH AFRICA, REPUBLIC OF
Pretoria, Atomic Energy Board Library

SPAIN
Madrid, Junta de Energia Nuclear, Ciudad Universitaria

SWEDEN
Nyköping, Aktiebolaget Atomenergi Library

SWITZERLAND
Zürich, Swiss Federal Institute of Technology

UNITED KINGDOM
Harwell, Didcot, Berkshire, Atomic Energy Research Establishment
London, National Reference Library

IN INTERNATIONAL AGENCIES

EUROPEAN ATOMIC ENERGY COMMUNITY (EURATOM)
Brussels, Belgium
Ispra Varese, Italy, Cetis Library

OECD NUCLEAR ENERGY AGENCY (NEA)
National Lending Library for Science and Technology, Boston Spa, Yorkshire, England

INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)
Vienna, Austria

UNITED STATES
GOVERNMENT PRINTING OFFICE
DIVISION OF
PUBLIC DOCUMENTS
WASHINGTON, D.C. 20402

OFFICIAL BUSINESS

POSTAGE AND FEES PAID
U S GOVERNMENT PRINTING OFFICE

U.S.MAIL

neptunium-237

PRODUCTION AND RECOVERY

AEC Critical Review Series

Wallace W. Schulz and Glen E. Benedict
Atlantic Richfield Hanford Company
Richland, Washington

November 1972

The program to recover, purify, and irradiate (to ^{238}Pu) kilogram quantities of ^{237}Np, begun in 1957 by the U. S. Atomic Energy Commission, is now in full fruition. Time-tested schemes are in place at both the Hanford and Savannah River sites for routine recovery of neptunium. It is clear, however, that U. S. production and recovery of ^{237}Np is slowly shifting from government to commercial facilities. The imminent shutdown of the Hanford Purex plant and loss of its neptunium output will hasten this shift. This review provides valuable background information on neptunium recovery methods for new plants.

The authors have covered all the known methods that have been developed for recovering neptunium, including several no longer in use. They accomplish the following objectives: focus attention on techniques for recovering ^{237}Np from aqueous nitrate media; update chemical flow sheets; review critically and concisely more than 10 years of plant experience and associated research and development; evaluate foreign experience; evaluate plans of domestic commercial fuel reprocessors to recover neptunium; review the current status of nonaqueous technology for recovering neptunium; and project the supply and demand for ^{237}Np.

85 pages, 7 by 9¾ inches, paperbound
International Standard Book Number: 0-87079-001-3
Library of Congress Catalog Card Number: 72-600249

The use of ^{238}Pu may well change from relatively small scale space applications to projected large scale medical uses, such as a power source for artificial hearts and cardiac pacemakers. With less government and more private involvement, such a change would mean that power reactor fuels in private reprocessing plants would become the new source of ^{237}Np, the precursor of the valuable isotopic power source ^{238}Pu.

CONTENTS

Neptunium-237 Supply and Demand
  Production and Availability
  Use and Demand
Recovery of Neptunium from Aqueous Solutions
  Solvent-Extraction Processes
  Ion-Exchange Processes
  Precipitation Processes
  Separation of ^{237}Np and ^{238}Pu
  Neptunium Recovery in Commercial Reprocessing Plants
Nonaqueous Methods for the Recovery and Separation of Neptunium
  Fluoride-Volatility Processes
  Volatility Separation of $NpCl_4$
  Pyrochemical Processes
Author and Subject Indexes

Available as TID-25955 for $3.00 from
National Technical Information Service
U. S. Department of Commerce
Springfield, Virginia 22151